Electrical Contracting

SEPTEMBER
1946

PLANT WIRING AND RE-WIRING SIMPLIFIED

G-E No. 1799 VARNISHED-CAMBRIC INTERLOCKED-ARMOR CABLE MEANS

Quicker wiring today
Easier circuit changes tomorrow

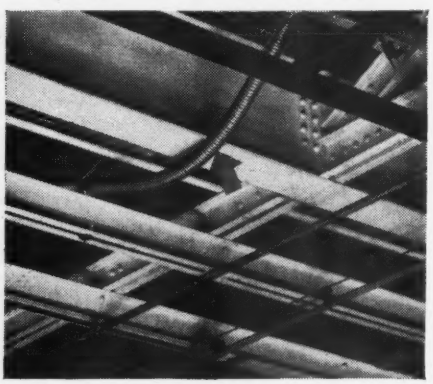
No. 1799 Varnished-Cambric Interlocked-armor Power Cable (600 volts)

Plants which met wartime deadlines for wiring time by the use of G-E interlocked-armor cable are among the big boosters for its peacetime use. It permits faster installation of power distribution systems—both primary and secondary circuits. Future relocation problems are simplified, too, because existing cable and fittings are easily adapted to new circuits.

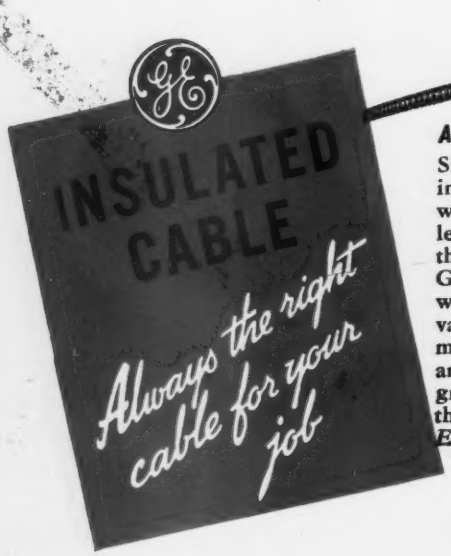
General Electric's No. 1799 varnished-cambric interlocked-armor cable—adopted to meet the urgent demands of speedy wartime installation—provides many time- and money-saving features for plant wiring. Actual installation time for power circuits can be cut as much as 50 per cent with this flexible cable for two reasons: (1) steel conduits and pull boxes are not necessary, and (2) comparatively little time is needed for layout of circuits because the cable can easily be bent around beams and obstructions. Other plant equipment can be erected immediately without "marking time" while waiting for wire and conduit systems to be put in place.

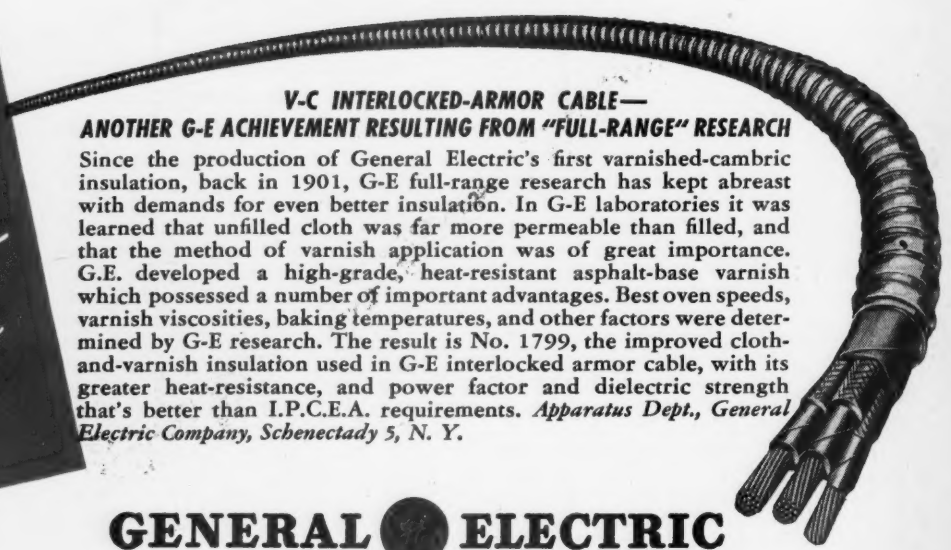
The initial cost of G-E interlocked-armor cable power distribution systems is frequently 25 per cent lower than for comparable wire and conduit systems, while high salvage value cuts the cost of changing circuits to meet varying load conditions. Important savings of steel and copper are made, and improved voltage regulation due to closer spacing of conductors results in increased machine output.

Large structural beams are easily by-passed



It will pay you to investigate these and other advantages before wiring new plants, or altering present power distribution systems. Your local G-E representative has the complete story.





V-C INTERLOCKED-ARMOR CABLE—
ANOTHER G-E ACHIEVEMENT RESULTING FROM "FULL-RANGE" RESEARCH

Since the production of General Electric's first varnished-cambric insulation, back in 1901, G-E full-range research has kept abreast with demands for even better insulation. In G-E laboratories it was learned that unfilled cloth was far more permeable than filled, and that the method of varnish application was of great importance. G.E. developed a high-grade, heat-resistant asphalt-base varnish which possessed a number of important advantages. Best oven speeds, varnish viscosities, baking temperatures, and other factors were determined by G-E research. The result is No. 1799, the improved cloth-and-varnish insulation used in G-E interlocked armor cable, with its greater heat-resistance, and power factor and dielectric strength that's better than I.P.C.E.A. requirements. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

501-31-1200

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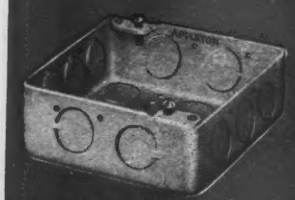
Cable address: "McGraw-Hill, New York." Member A. B. P. Member A. B. C.

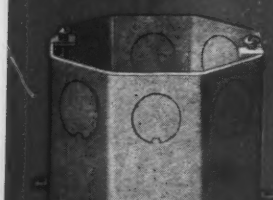
"LET'S HAVE APPLETON FITTINGS ...THEY'RE JUST WHAT WE WANT"

OUTLET BOXES

Outlet boxes shall be Galvanized and made by Appleton Electric Company. Flush ceiling boxes shall be No. OCR-3½ concrete boxes with No. OCP ⅜ cover with ⅜ fixture stud. Flush wall outlets shall be 4-S-¾ with 1 gang or 2 gang covers. Bracket light outlets and exit light outlets shall be equipped with ⅜" Appleton 8056 no bolt fixture studs. Only knockouts used shall be removed.



Appleton 4-S-¾ Outlet Box (left) specified above for flush wall outlets. Appleton boxes are available in any desired type and size with wide range of cover designs. No. 8468 Single Cover shown above.



Appleton OCR-3½ Concrete Box (left) inside lugs drilled and tapped to take OCP plates or any standard make, 4-inch round box cover. OCP-⅜ plate (above) has ⅜ fixture stud.

Appleton 8056, ⅜-inch open type Boltless Fixture Stud (right). Closed type also available.

Send Today!

Big Appleton Catalog, describing and illustrating more than 15,000 types and sizes of wiring equipment, gladly sent on request to any user of such material.

A SIZE AND TYPE FOR EVERY ELECTRICAL REQUIREMENT

. . . from simplest to most exacting

". . . made by Appleton Electric Company." *Period.* That is one specification that stands for first-class work . . . that says clearly: "Quality comes first on this job."

Whether it's a big factory job like the recent one specified above, or a complicated system of wiring for a highly hazardous location, you can depend on Appleton material to be expertly and cleanly made, and skilfully designed for easy installation and wiring. Appleton quality is carefully maintained and safeguarded in Appleton's own foundries and fabricating plants.

Save your own time... build better... by specifying Appleton fittings, the STANDARD FOR BETTER WIRING.

APPLETON ELECTRIC PRODUCTS REG. U.S. PAT. OFF.

Sold Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

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Resident Representatives: Cincinnati, Dallas, Kansas City, Milwaukee, New Haven, New Orleans, Seattle.

APPLETON

CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

Electrical Contracting

. . . Contents for September, 1946

With which is consolidated The Electragist and Electrical Record . . . Established 1901

Departments

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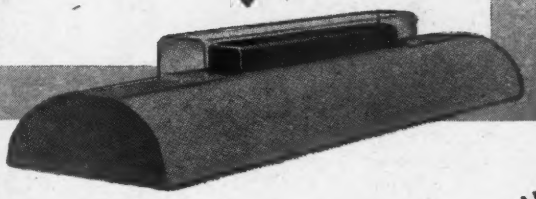
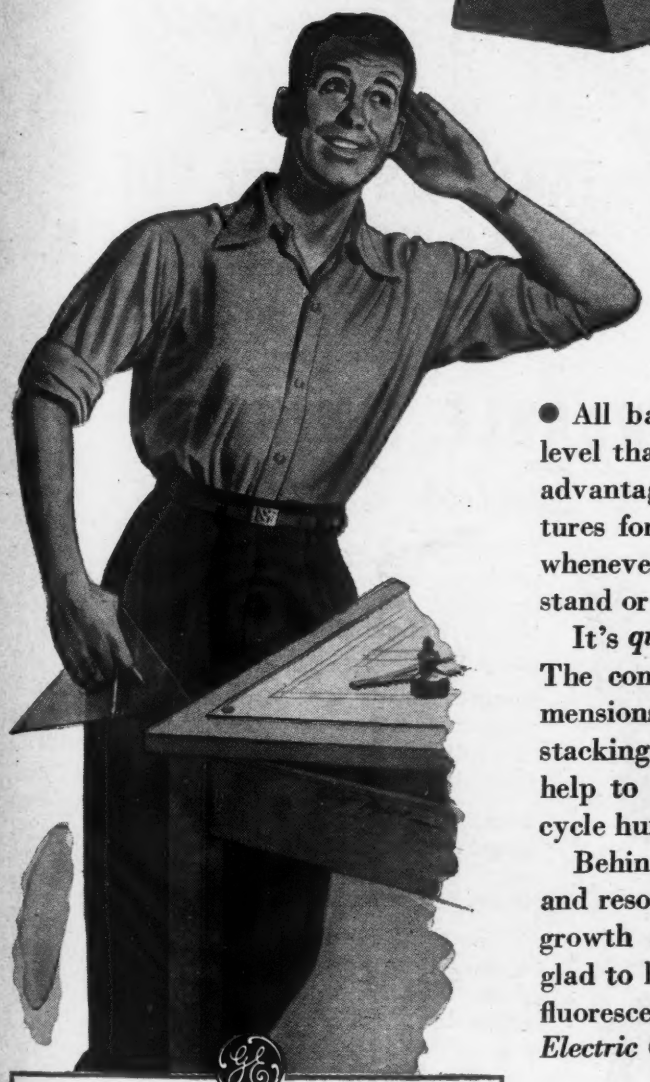
Quiet...
as a cat on velvet





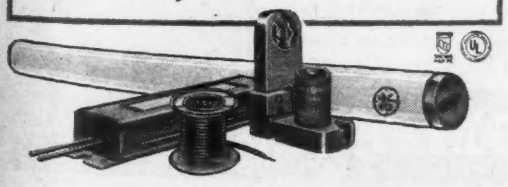
General Electric BALLASTS
HELP KEEP FIXTURE USERS SATISFIED ...
THEY MEAN ADDED PROFITS FOR YOU!

● All ballasts hum, just as all cats purr; but a sound level that stays so low as to be unnoticeable is a major advantage of G-E ballasts. On fluorescent lighting fixtures for offices, hospitals, drafting rooms, studios, and whenever low noise level is the rule, your reputation may stand or fall on this factor alone.

It's *quality construction* that keeps G-E ballasts quiet. The composition of the core steel, the accuracy of dimensions of the laminations, the uniformity of core stacking, the strength of the clamping structure—all help to make a cohesive unit tending to damp the 60-cycle hum.

Behind the design of G-E ballasts are all the research and resources which G.E. is concentrating on the steady growth of fluorescent lighting. Our engineers will be glad to help you select and apply ballasts or other G-E fluorescent fixture components. *Apparatus Dept., General Electric Co., Schenectady 5, New York.*

BALLASTS · LAMPS · STARTERS
LAMPHOLDERS · CABLE
for Dependability



1 Low noise level—for satisfied users

2 Long life—for low replacement cost

3 Characteristics matched with lamp—for rated lamp life and light output

4 Dimensions that permit use of one wiring channel for practically all fixtures—for simplified parts inventory and lower fixture cost

GENERAL ELECTRIC

NO MANUAL CHANGING OF THE DIALS . . . . .

SANGAMO

Astronomic Dials

TAKE "ON" AND "OFF" TIMES FROM THE SUN

•

DEPENDABLE TIMING *A Sales Builder . . .*

FORM KAZ
SYNCHRONOUS MOTOR
WITH ASTRONOMIC DIAL

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff.

FORM VSWZ WITH
ASTRONOMIC DIAL CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of resetting the dial after current interruptions, and insures accurate timing under all conditions.

Both of the Sangamo Time Switches shown here are equipped with Astronomic Dials.

There are so many advantages that go with a SANGAMO TIME SWITCH equipped with an ASTRONOMIC DIAL, it's no wonder this line of switches gets sales preference.

Regardless of the lighting application, your customers benefit day after day from this full automatic control and exceptional flexibility.

Each day the astronomic "on" and "off" operations automatically change to conform exactly to the rising and setting times of the sun.

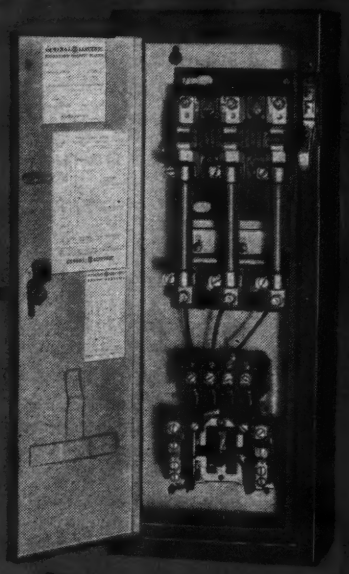
These dials permit of the "off" operation at any time between 9:30 P.M. and 2:15 A.M. Special operating schedules are available.

SEND FOR
Catalog 1000

To help you in selling SANGAMO TIME SWITCHES, write today for catalog which describes the line and gives details on the ASTRONOMIC DIALS. There are eleven forms of these switches supplied with ASTRONOMIC DIALS which include outdoor types.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Sacking the seeds, one of the many processes controlled by G-E combination starters at the Rohnert plant



59 G-E COMBINATION STARTERS Control the Processing of 1/4 of the World's Vegetable Seeds

COMBINATION STARTERS SAVE TIME, SPACE, AND MONEY

Every process from eliminating dirt and debris to sorting the seed to size is controlled by G-E combination starters at the Waldo Rohnert Co., world's largest producers of garden vegetable seed.

In their four-story plant, completed in 1944, and said to be the most modern of its kind in the country, ¼ of the world's garden vegetable seed is processed—that's far more than a million pounds of clean seed a year. All electrical, it boasts 59 General Electric CR7008 combination starters and supplementary control which regulate the five separate seed mills of their complicated seed mill system.

According to Fred Rohnert, son of the founder, *"Our G-E controls and equipment have proved extremely satisfactory. They've given us no trouble since their installation."*

And here's why these starters have proved so satisfactory—

COMBINATION STARTERS SAVE TIME—

In addition to the time saved in ordering, outstanding savings in installation time are made with these starters. Users report a 50 per-cent reduction in mounting time, a 40 per-cent reduction in wiring time, as compared with the installation of two separate devices. You connect to only 9 terminals instead of 15.

SPACE—

Valuable wall space is saved because combination starters can be installed in small, unused places either near to or remote from the operator.

AND MONEY—

While the list price is slightly higher than for two separate devices, the difference is more than made up by savings in wire, fittings, and time.

WHAT IS YOUR APPLICATION?

Combination starters come in a variety of enclosures to meet any operating condition in your plant. If you'd like more information, ask our nearest office for Bulletin GEA-2715A. And remember, our engineers will be glad to help you with your application. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC

876-201-8910

She needs your scrap to make steel NOW

THE present critical shortage of scrap is a serious threat to steel production.

America was literally picked bare of scrap during the war years. In recent months, industries which usually generate large quantities of scrap have been operating at low level or not at all. The result is that scrap inventories at the mills are little better than in 1942 when some open hearth furnaces were forced to shut down for lack of scrap.

Every user of steel has a direct stake in the scrap shortage. Without more scrap, producers cannot furnish you the steel needed so urgently now.

If you want steel, you can help yourself to get it by doing your bit immediately to start more scrap into channels that serve the

QUALITY YOUNGSTOWN SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

GENERAL OFFICES · YOUNGSTOWN 1, OHIO

Export Offices - 500 Fifth Avenue, New York City

Manufacturers of

CARBON · ALLOY AND YOLOY STEELS

Pipe and Tubular Products-Sheets-Plates-Conduit-Bars-Electrolytic Tin Plate-Coke Tin Plate-Rods-Wire-Cold Drawn Carbon Steel Rounds · Tie Plates and Spikes.

Buy Safer, Smaller

CLASS "B" INSULATED DRY-TYPE TRANSFORMERS!

Comparison shows you get easier installation... safer operation ...and longer transformer life!

FEATURES	Allis-Chalmers	Make "B"	Make "C"	Make "D"	Make "E"	Make "F"	Make "G"
Class "B" Insulation	YES	YES	YES	NO	NO	NO	NO
Light Weight, Compact	YES	YES	YES	NO	NO	NO	NO
Clamp Connectors on Some Sizes	YES	NO	NO	YES	NO	NO	NO
Solidly Enclosed Core & Coils	YES	NO	YES	YES	NO	NO	NO
Liberal, Accessible Wiring Compartment	YES	YES	YES	YES	NO	NO	YES
Modern, Attractive Appearance	YES	NO	YES	YES	NO	NO	NO

CORE AND COIL assembly shows Class "B" insulation which protects against moisture, eliminates use of combustible materials and fireproof vaults. Note also the rigid terminal board with clamp connectors — a standard feature of the new improved Allis-Chalmers transformers.

You can choose from new BD and BDT units in 14 sizes, ranging from 1½ to 200 kva, single-phase, and 10 to 300 kva, three-phase.

Class "B" insulation in Allis-Chalmers new BD and BDT Dry-Type Transformers reduces overall size *as much as 1/3* over conventional Class "A" insulated types — reduces weight *22 to 38%*.

This simplifies installation ... enables you to locate secondary power *almost any place* you want it!

You'll need less mounting materials — will get longer service for no increase in cost over Class "A" insulated types. It adds up to lower overall cost for you!

For complete details get in touch with your nearest Allis-Chalmers dealer or sales office, or send for new bulletin B6382. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN.

A2097

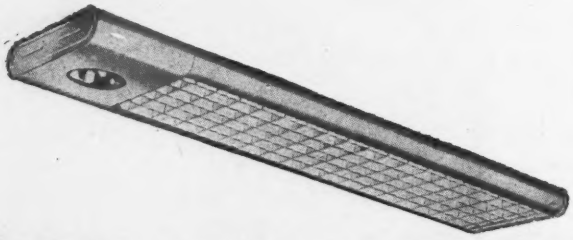
ALLIS CHALMERS **DRY-TYPE TRANSFORMERS**

LEADER ELECTRIC MFG. CORP.

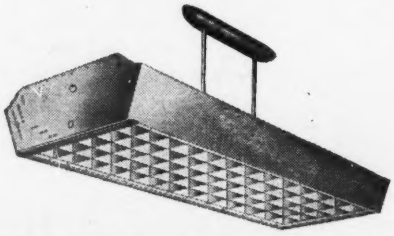
6127 BROADWAY — CHICAGO 40, ILLINOIS

Leader Leader Fluorescent Light Fixtures are designed, engineered, and manufactured by this experienced organization to specifically meet the modern lighting needs of America's industrial and commercial organizations. The line is recognized from coast to coast for its top standards of quality and workmanship.

Leader Leader Fluorescent Light Fixtures are being specified by leading architects and the trade accepts them both for their effectiveness, their salability, and their profit. Jobbers and Dealers will find that this line measures up to their ideas of correct units for today's big sales opportunity.

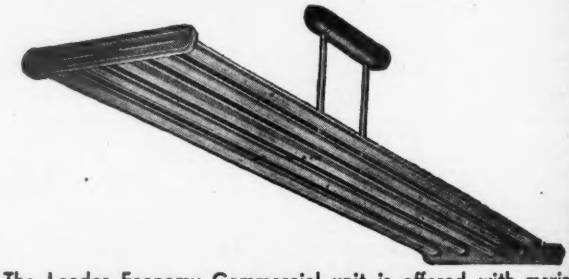


The Leader "Officer"—Model VL-440 can be mounted either flush or suspended in single or continuous run installations. Continuous run installations using suspended or surface mounted fixtures are simply made by connecting band between fixtures, fattened with two thumb screws. No bushings or lock-nuts are needed between fixtures for continuing the wiring channel as all openings are grommeted when manufactured. Special self-locking mounting tracks offer unusual ease and simplicity of installation. Hinged snap lock louvre provides swift simple servicing. Model VL-440—"OFFICER" uses two or four 40-watt T-12 lamps—two certified H. P. F. ballasts—four FS-4 easily replaced starters. Length 49 11/32"—width 16 1/8"—depth 5 3/16". DIRECLITE, made to fit on office unit, for spotlighting of merchandise. SPOT can be tilted 50°. Uses one P.A.R. 38 bulb.



The Leader LR-440 URC Research Luminaire may be individually mounted by ceiling or pendant suspension or installed in continuous row mounting. Finished in rich silver gray enamel with high reflecting chip proof white enamel throughout. Knockouts provided on top for stem mounting and also in center of sides for connection to ceiling outlet. Knockouts also provided for nipple and locknut, serves to lock fixture sections together and provide raceways for sides from one unit to another. Track sections constructed of No. 18 USSG steel. Available with either glass or louvre bottom.

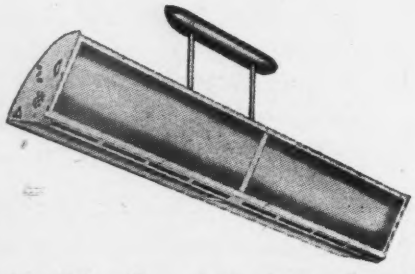
The Leader G-440 is an ideal unit for schools, offices, and institutions. Designed for four 48-inch 40-watt lamps, latest type Underwriters Laboratories Approved high power factor ballasts and FS-4 replaceable starters. Overall length 48¼"—overall width 12½"—height 7½". 110-125 volts, 60 cycle, A.C. operation. Glass panel hinge for easy lamp installation and servicing. Other voltages on request.



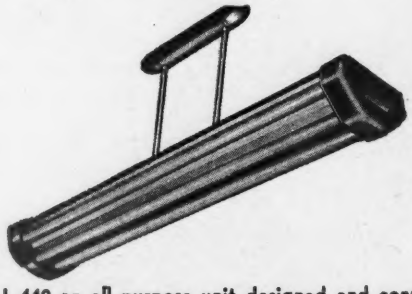
The Leader Economy Commercial unit is offered with maximum efficiency and versatility in a moderate priced lighting unit. Can be installed in continuous rows—either pendant or ceiling mounting. Has special self-locking mounted tracks for unusual ease and simplicity of installation for ceiling attachment. Fixtures is designed for mass light output, essential for laboratories, drafting rooms, hospitals, stores and large offices.

..For 110-125-volt, 60-cycle A.C. operation. Can be furnished for 220-volt on request.

Dimensions: Length, 49½ inches; width, 16 inches; height, 3⅛ inches.

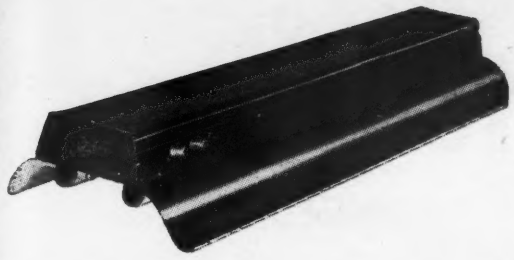


The Leader GL-440 for offices, schools, stores—where a large output of diffused light is required. Designed for two or four 40-watt lamps, Tulamp high power factor ballast and replaceable FS4 starters. Over-all length 48¼". Over-all width 13¾". Height 7¾". Frame 18 gauge, housing 20 gauge cold rolled prime quality steel. Glass panel hinge for easy lamp installation and servicing. Finished in satin aluminum, reflector finished in white high gloss, chip proof baked enamel. Also available as 2 light units. GL-240 similar in design and construction to the GL-440.



The Leader L-440 an all purpose unit designed and constructed for installations requiring quality and detail in appearance as well as maximum widespread illumination. Designed for four 48" 40-watt lamps, latest type Underwriters Laboratories Approved high power factor ballasts, and FS-4 replaceable starters. 110-125 volts, 60 cycle, A.C. operation, other voltages on request. Length 50½"—width 9½"—height 5½". Hinged end caps for lamp replacement. Easily removable reflector. Also available in Model L-240, companion unit similar in design but uses only two bulbs.

ALL LEADER UNITS AVAILABLE • •



The Leader Model IUO-240 Stratoliner. New, strong, and efficient, all-steel heavy duty lighting unit for two 40-watt, T-12 Fluorescent Lamps. Encloses all auxiliary equipment in accessible, ventilated channel. For direct-to-ceiling or suspension mounting by means of various accessories. Choice of Baked Enamel or Porcelain Enamel Reflectors. All reflectors are equipped with captive knurled nut for easy servicing. Completely wired and ready to install, including approved 95% p.f. corrected ballasts, approved twist lock sockets, and replaceable starters. Available also for Instant Start operation. Conventional 110-125 volts, 60 cycle, A.C. Other voltages and frequencies on request.

The Leader Model IUO-340 Stratoliner has same specifications as IUO-240 except it takes three 40-watt, T-12 Fluorescent Lamps.

The Leader Model IUP-240 Stratoliner, similar in design but it has porcelain closed end reflector.

The Leader Model IUO-2-100, similar to Stratoliner construction. Takes 2, 100-watt lamps. Also IUP-2100 with porcelain closed end reflectors.

The Leader Model ZUO-240 Zephrylite. Corrugated for unusual strength. Designed for individual and continuous row mounting, the Leader ZUO-240 is constructed to take two 40-watt T-12 Fluorescent Lamps. Underwriters Approved, Tulamp, HPF ballasts. Reflector and starter plates provided with knockouts for addition of third lamp of desired. Channel constructed to take sliding clamp hangers. Channel design provides complete accessibility to entire wireway. Removable rectangular knockouts adapt unit to continuous run installation. Reflector constructed of high quality cold rolled steel, open end, with double coated, baked enamel finish. All reflectors equipped with captive, knurled mounting nuts. Also available in porcelain—ZUO-P-240. Length 51", width 13⅝, height 7". Electric supply service. 60 cycle, 120 volt, A.C. Other voltages available on request. Available with 3 40-watt T-12 bulbs, with porcelain closed end reflector and with 100-watt equipment.

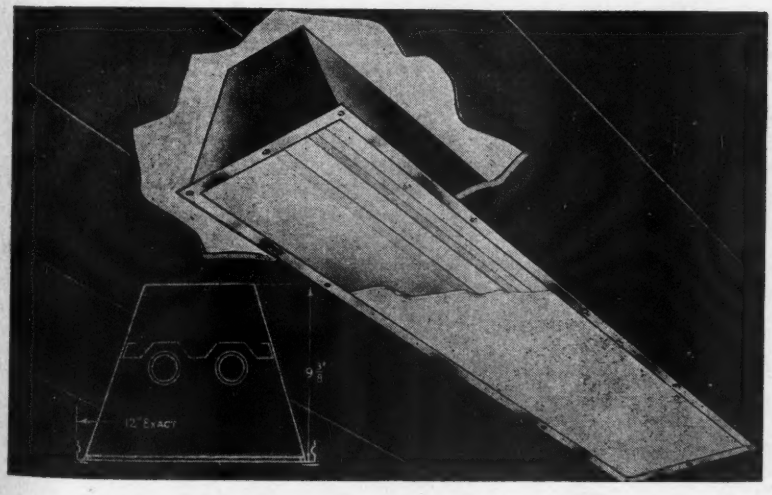
TROFFERLITE -RECESSED UNITS FOR EVERY INDIVIDUAL NEED

12-Inch Width **T Series**

FOR 1, 2 OR 3, 40-WATT, 48-INCH FLUORESCENT LAMPS

24-Inch Width **TW Series**

For 2, 3 or 4, 40-Watt, 48-inch Fluorescent Lamps



General Features and Specifications

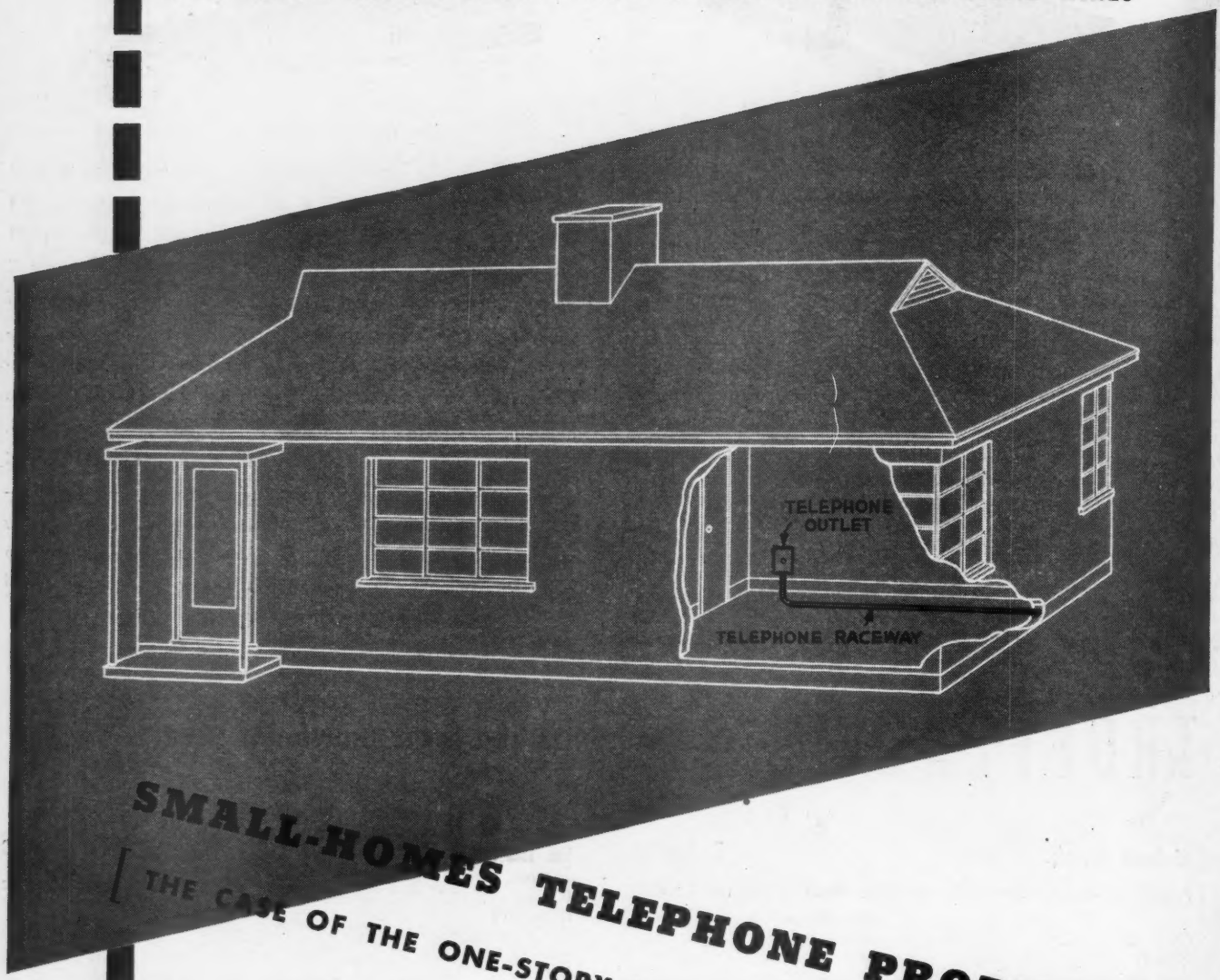
- FOR NEW CONSTRUCTION OR REMODELING—FOR REMODELING, CEILINGS *CAN ACTUALLY BE HUNG TO THE UNITS.*
- CONVERTIBLE SINGLE UNITS OR CONTINUOUS RUNS.
- HOUSING AND REFLECTORS OF 20 GAUGE STEEL.
- FINISH—BAKED WHITE ENAMEL THROUGHOUT.
- OVER 90% REFLECTION FACTOR FOR REFLECTOR SURFACE.
- VARIETY OF MOUNTING METHODS.
- REFLECTORS REMOVABLE FROM BELOW AFTER INSTALLATION.
- ALZAK ALUMINUM REFLECTORS AVAILABLE ON SPECIAL ORDERS.
- CONVENIENT WIRING KNOCKOUTS AND MOUNTING SCREW HOLES AS SHOWN ON DIMENSION DRAWINGS.

The simplicity of Trofferlite construction design permits mass production of standard equipment and thus enables Leader to offer the splendid advantages of Trofferlite construction at very attractive prices.

A Custom Job at Prices of a Standard Product . . . with the Leader Line of Recessed Troffer fluorescent lighting units, made possible by an engineering achievement of exceptional merit. Through the utmost simplification of design features in the Leader Trofferlite it is now possible to meet every troffer lighting requirement with standardized units. Modern design is best served by recessed Troffer units either in new construction or remodeling.

• •. FOR INSTANT START OPERATION

EVEN SMALL HOMES SHOULD HAVE RACEWAYS FOR TELEPHONE WIRES



SMALL-HOMES TELEPHONE PROBLEMS

[THE CASE OF THE ONE-STORY HOUSE WITHOUT A BASEMENT]

Telephone raceways offer opportunities for additional profits even in small homes.

In homes without basements the telephone installer generally cannot run wires up through the floor to the telephone location. A wiring channel leading to a convenient telephone outlet should be installed before the floor is laid. This will avoid attaching telephone wires in plain sight on baseboards and around window and door frames.

By pointing out these facts to architects, builders and buyers, you do them—and yourself—a service.

Remember—NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT INCLUDES A RACEWAY FOR BUILT-IN TELEPHONE FACILITIES.

BELL TELEPHONE SYSTEM

Check List

OF ALLIS-CHALMERS POWER, ELECTRICAL, AND INDUSTRIAL PRODUCTS

☐ MOTORS

You can depend on Lo-Maintenance Motors for all power drives of one hp and up. Available in all most-used types: squirrel cage, wound rotor, synchronous, direct current . . . with electrical and mechanical modifications to fit the job. Enclosed fan-cooled and explosion-proof motors available to 1000 hp.

☐ MOTOR CONTROL

Standard line for every requirement of motor operation: manual or magnetic, reversing and non-reversing; across-the-line; or reduced voltage; single or multi-speed. NEMA sizes.

☐ TRANSFORMERS

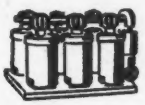
Whatever your power distribution problem, there is an Allis-Chalmers transformer to take care of it. Oil and non-inflammable liquid filled transformers are available from 1½ kva to largest power types; dry type built from 1½ to 2000 kva. Installed anywhere.

☐ SWITCHGEAR

All types of switchgear: indoor and outdoor, with circuit breakers to suit application; switchboards of all types custom built to suit needs; circuit breakers from 15,000 kva to 3,500,000 kva I. C.

☐ UNIT SUBSTATIONS

Factory built, metal enclosed unit substations built for indoor or outdoor operation. Load Center units can be installed on balconies or in other space saving locations.



☐ RECTIFIERS

Power rectifiers convert a-c to d-c without moving part, noise, or vibration: are especially suitable for automatic operation—can be started instantly on load demand. New "sealed tube" Excitron can be installed in metal enclosure as part of unit substation.

☐ MOTOR-GENERATORS

Standard sets are available in ratings 1 kw and larger for commercial voltages and frequencies. Also built for special purposes as with flywheels for hoist service, to support mill motors, as frequency changers, balancers, boosters, and equalizing sets.

☐ FEEDER VOLTAGE REGULATORS

Step feeder voltage regulators improve regulation on all power lines . . . require one-third the exciting current of induction type.

☐ GENERATORS

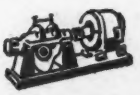
Allis-Chalmers builds a-c and d-c generators of all commercial characteristics and practical capacities . . . turbo, water wheel, engine, coupled, and belted types.

☐ POWER EQUIPMENT

Steam turbines from 10 to 200,000 hp . . . for mechanical drives and as part of turbo-generator units. Hydraulic turbines in Francis, propeller and impulse types especially designed. Gas turbines to 10,000 hp. Other power plant equipment includes surface condensers, air ejectors, deaerating heaters, water conditioning equipment and service.

☐ V-BELT DRIVES

Texrope is the trade name of Allis-Chalmers V-belt drive products. Super-7 Texrope belts and Texrope sheaves are available in sizes and types to suit every application from fractional hp to 6000 hp . . . variable speed from fractional to 300 hp. New Magic-Grip sheaves quickly installed or removed.



☐ CENTRIFUGAL PUMPS

Sizes and types to handle from 10 to 600,000 gpm . . . heads to 3500 ft or more. Compact Electrifugal pumps have wide application. Self-Priming Pumps, Solids-Handling Pumps, and a new type of pump for handling chemicals.

A 2028

☐ WELDING EQUIPMENT

Consistently sound, uniform welds are provided by Ampac's steady arc . . . without troublesome arc blow. Special magic arc control provides correct arc striking voltage automatically—every time. These transformer type welders are available in 200, 400, 750 and 1000 amp. sizes. Complete line of electrodes using AWS numbers.

☐ ELECTRONIC HEATING

Electronic heaters provide industry with a new production tool that puts the right amount of heat in the right place. They are easy to operate and can be set for automatic timing. Available now in two types . . . induction, for heating of conductors . . . and dielectric, for heating of non-conductors. Many sizes.

☐ BLOWERS, COMPRESSORS

Sliding-vane air compressors provide non-pulsating air for pneumatic operations . . . dry vacuum pumps provide vacuums to 27 in. of mercury. Single and multi-stage centrifugal blowers provide up to 150,000 cfm with pressures up to 135 psig.

☐ PROCESSING INDUSTRIES

Allis-Chalmers also builds major equipment for these basic unit operations: Crushing; grinding; pulverizing; shredding; sawing; milling; flaking; screening; ore; sand and stone washing; classifying; concentrating; melting; drying; cooling; dissolving; hydro-processing; pyro-processing; oil extraction; and many others.

FOR DETAILS GET IN TOUCH WITH LOCAL A-C OFFICE

A phone call will bring the famous problem-solving experience of Allis-Chalmers engineering to your business. Call A-C office nearest you. ALLIS-CHALMERS, MILWAUKEE.

ALLIS A-C CHALMERS

One of the Big 3 in Electric Power Equipment—
Biggest of All in Range of Industrial Products

THE


For Lasting Wiring Protection
latest rules and requirements
National Electrical Code.
RACEWAY SPECIFICATIONS
All electrical conductors shall be enclosed in ELECTRUNITE E.M.T., or equal, in sizes 1/2" to 2", inclusive. Tubing shall be steel, electrically welded, electro-galvanized and manufactured in accordance with Underwriters' Laboratories Standards, and so indicated.
Couplings and box connectors shall be water-tight, Underwriters Approved and so labeled.
CTION BOXES
be placed in connection
E.M.T.,
bar joists
ecured

MODERN WAY....

is the ELECTRUNITE *Way*

Bring your wiring "SPECS" Up-to-Date with Safe, Economical ELECTRUNITE E. M. T. . . . The Streamlined Wiring Raceway

● Two primary purposes of electrical raceway specifications are: (1) To provide adequate, lasting protection to wiring, and (2) to assure economy in first cost and maintenance expense.

From both standpoints, it pays to include Republic ELECTRUNITE E. M. T.— the *original* lightweight rigid steel raceway.

This modern raceway is made from tough, strong, abuse-resistant steel. It is fireproof, waterproof and tamperproof. It requires less room in concrete slabs and partitions. And its tightly-adherent zinc coating provides continuous rust- and corrosion-resistance—unbroken by threads—throughout the installation.

These are but some of the reasons why ELECTRUNITE E. M. T. meets Underwriters' Laboratories requirements . . . why, too, it is approved by the National Electrical Code for exposed, concealed and concrete slab construction.

And because it is *threadless*—requires no old-fashioned thread-cutting, *light in weight* for easier handling, and *easy to bend* with predetermined accuracy, ELECTRUNITE E. M. T. saves countless installation dollars—keeps jobs moving on schedule.

On every job, insist that electrical specifications include genuine ELECTRUNITE E.M.T. For further information about this up-to-date raceway, see your ELECTRUNITE DISTRIBUTOR, or write to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

. . . IN SCHOOLS

. . . IN OFFICE BUILDINGS

. . . IN GOVERNMENT BUILDINGS

Republic
ELECTRUNITE E.M.T.
REG. U. S. PAT. OFF.
LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY


FLAMENOL
STYLE FL
INSULATED
WIRE and CABLE
GENERAL ELECTRIC

FLAMENOL FOR TOUGH WIRING JOBS

GIVES THESE 12 BIG BENEFITS

1. **FLAME RESISTANT**—does not support combustion.

2. **CORROSION RESISTANT**—immune to action of oils, acids, alkalies normally encountered in service.

3. **AGELESS**—does not oxidize. Highly resistant to sunlight and weather.

4. **EXCELLENT PHYSICAL PROPERTIES**—has minimum tensile strength of 1500 pounds per square inch; minimum elongation of 100 per cent.

5. **SUPERIOR DIELECTRIC STRENGTH**—Tests on No. 14 wire with 2/64-in. insulation show a breakdown strength of 720 volts per mil.

6. **SMALL DIAMETER**—saves space; makes wiring easier.

7. **SMOOTH, TOUGH SURFACE**—makes pulling through conduit easier and quicker.

8. **STRIPS CLEAN**—speeds soldering, splicing, terminating.

9. **DIFFERENT COLORS**—simplify hook-up and circuit tracing.

10. **VARIOUS TYPES**—aid selection for special applications.

11. **SELF-PROTECTING FINISH**—normally eliminates need for armor braid, requires less space.

12. **ATTRACTIVE APPEARANCE**—looks new, stays new over long periods of time; never needs painting but can be painted without harm.

For more information on Flamenol Style FL wire and cable, ask the nearest G-E office for a copy of GEA-4352, or write General Electric Company, Schenectady 5, N. Y.

502-61-1200

APPARATUS DEPARTMENT, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

Count on Gold Seal under any Conditions

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal specifications.

From the Arctic to the Equator, sea level to mountain top, wherever Gold Seal Friction Tape is used, its "tack" will never vary. That's because Jenkins closely controls and laboratory checks every step of its production. There's always plenty of "tack" in its friction compound. And every fibre of the cloth is thoroughly impregnated.

More than that, Gold Seal Friction Tape doesn't ravel or peel. It tears evenly – wraps without wilting or bulging. Every roll is cellophane wrapped, then boxed, to reach you factory fresh.

Try Gold Seal the next time you order tape. See how it helps you do work faster – do a better job, anywhere. Jenkins Bros., (Rubber Div.) 80 White Street, New York 13.

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Gold Seal Tapes

FRICTION and RUBBER TAPES

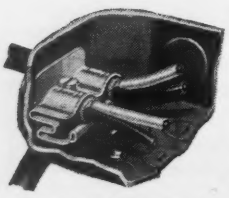
MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

Put away Webster, Professor, you won't find "Raco" listed there. But electrical contractors, architects and builders the country over will tell you RACO is the trademark for the All-Steel-Equip line of switch boxes and outlet boxes.

CHECK THESE RACO ADVANTAGES

- *They're clean.* Raco • All-Steel • Products bring you a smooth, attractive finish. No jagged or rough edges, no dirt or grease.
- *They're packaged.* Raco products come in neat, good-looking cartons. Cartons have a readable index clearly showing product number, quantity and finish.
- *They're uniform.* All-Steel has been making precision metal products for over 33 years. The Raco line is made with the same care—to the same exacting standards!

Remember, too, the Raco • All-Steel line is *sold nationally* through *wholesalers only.* You'll find it's the nation's quality line. Look for the Raco trademark—a sure sign of dependable products.



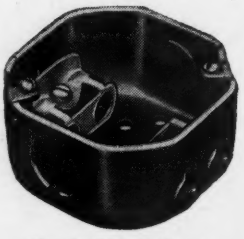
DO-21-N-3 3½" dia.
DO-16-N-3 4" dia.

Use Raco clamp type boxes to solve many of your connector worries.

DO-21-N-3, 3½" dia. is widely used with non-metallic cable.

DO-30-N, 3½" dia. is the perfect box for use with "BX."

ALL-STEEL EQUIPMENT, INC.
600 Kensington Avenue, Aurora, Illinois

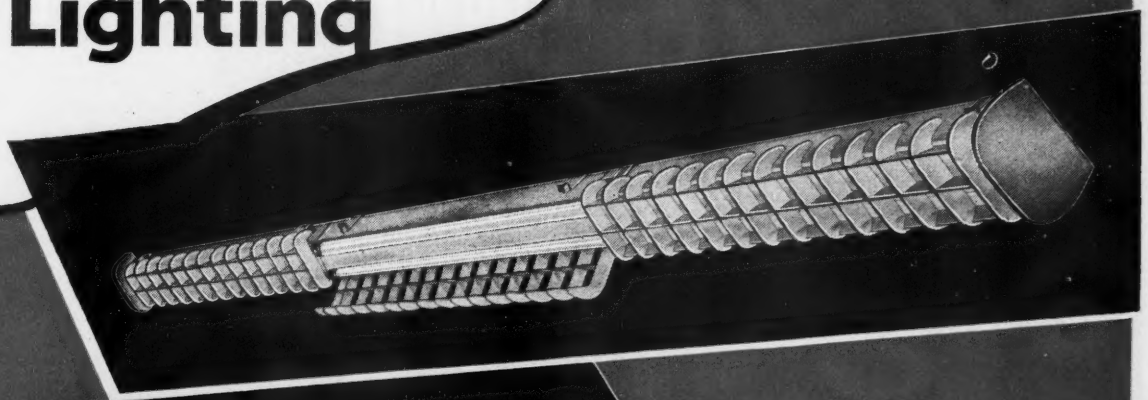


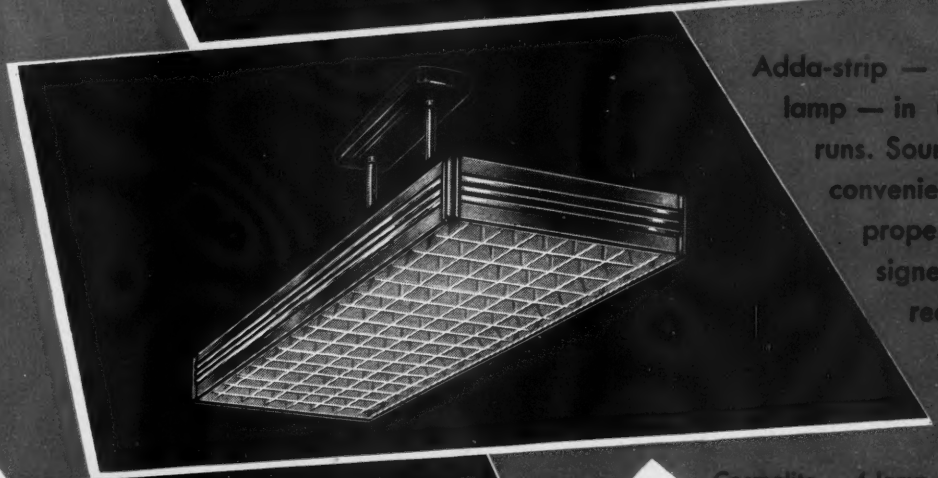
DO-30-N 3½" dia.
DO-31-N 4" dia.

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES

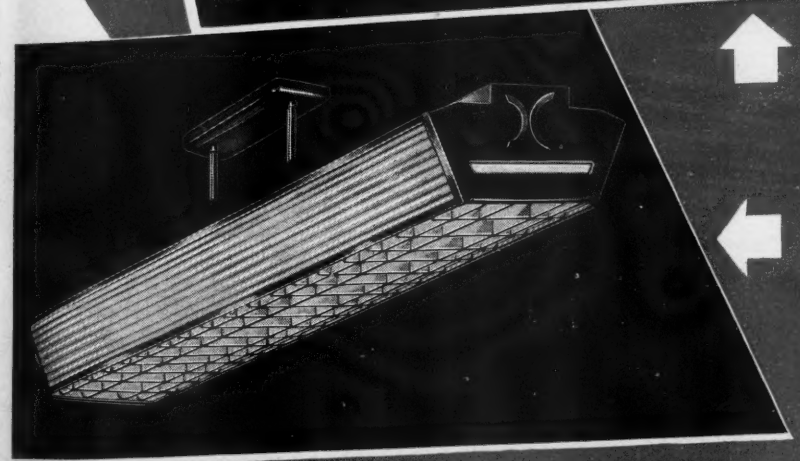
GARCY ..... *a name that stands for* TOP QUALITY in Lighting

GARCY means plus quality — for the installations that demand the best in lighting. That is why leading architects, designers and engineers repeatedly specify GARCY fixtures. Many outstanding installations throughout the country testify eloquently to GARCY superior quality.





Adda-strip — Single or multiple lamp — in units or continuous runs. Soundly engineered for convenient application and proper fit. All strips designed and machined to receive louvers and accessories.



Cosmolite — 4 lamp fluorescent fixture with louver bottom. A fixture of extraordinary beauty that combines high level illumination with low surface brightness. Made of polished aluminum with white enamel louvers.

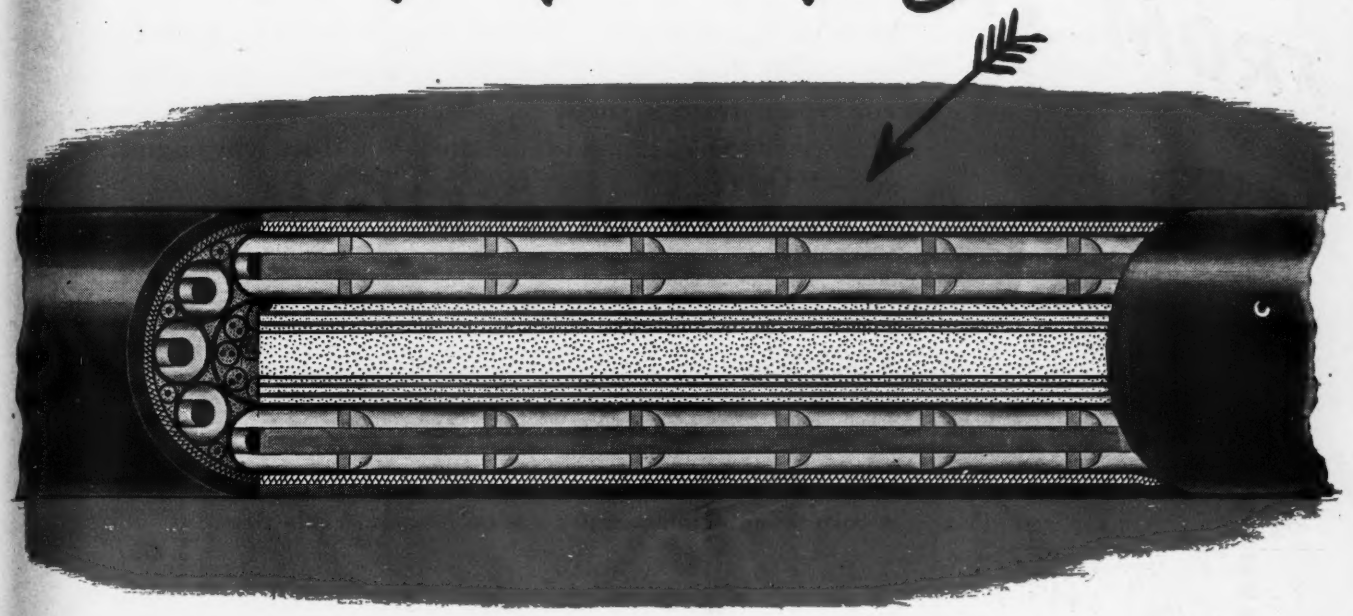
Stratolite — 2 or 4 lamp fluorescent fixture with louver bottom and Linex glass sides.

Both fixtures available suspended or surface mounted — individual units or continuous runs.

WRITE FOR CATALOGS

GARDEN CITY PLATING & MANUFACTURING COMPANY, INC.
Ogden Blvd. & S. Talman Ave. . . . . Chicago 8, Illinois
Since 1898 New York Office and Warehouse — 600 Broadway

Cross-section of 1400 people saying "Hello"



...and 1400 more answering, at the other end of this telephone cable, operating at less than peak capacity! It's coaxial cable, of course—a miracle that's already becoming a commonplace. And part of the miracle lies in the BAKELITE Polyethylene discs that safely and securely insulate the conductors and anchor them in position.

This plastic is remarkable, even among plastics. It is so light it floats on water. It is inherently flexible—extremely resistant to moisture and chemicals—outstanding in low-loss dielectric properties, with a constant of 2.29 at 50 mc. It is tough, and highly resistant to impact even at low temperatures, yet its temperature working range is wide, reaching from –60° F. to 185° F.

These are some of the reasons why BAKELITE Polyethylene insulation is supplanting older types...in power cable, where thin-wall flexibility is advantageous . . . in many electrical applications in industrial and automotive fields, where the unique properties of this insulation result in economies and superior electrical performance.

BAKELITE Polyethylene compounds are today commanding new attention in almost every line of manufacture. They are easy to process on standard equipment. No vulcanization is required. Write Department BA-41 for full information, experimental samples and booklet V-2, "Polyethylene Resins," completely describing their properties, uses, forms and fabrication procedures.

TRADE-MARKS

BAKELITE

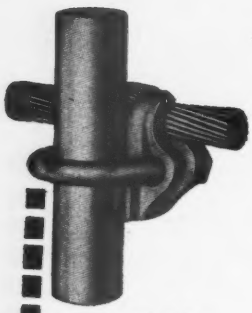
POLYETHYLENE

BAKELITE CORPORATION *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

O.Z. KNOWS CONNECTORS

FROM THE GROUND UP

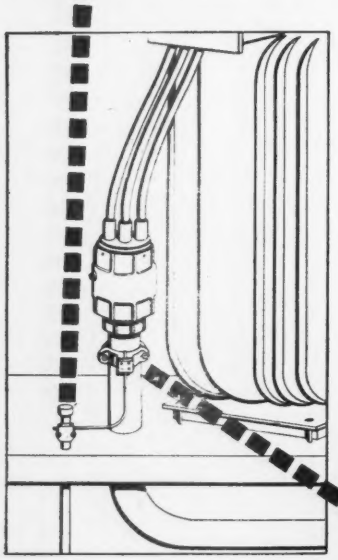
Whether in the depths of a mine or the towers of a skyscraper, wiring jobs done with O. Z. fittings *go in faster . . . stay in longer.* For typical reasons, check the advantages, below, of just two of the many O. Z. ground connectors. You'll see why engineers say— **"They're OK if they're O. Z."**



TYPE AG

TYPE AG GROUND CONNECTORS

- Top clamp plate is ribbed for strength . . . eliminates distortion.
- High-conductivity copper alloy . . . resists corrosion.
- Interlocking pivoted clamp insures maximum circular pressure.
- Single Everdur U-bolt secures cable to ground rod . . . reduces assembly time.
- Each fitting accommodates a wide range of cable sizes.



TYPE CG GROUND CONNECTORS

- Ground wire connects at right angles or parallel to pipe.
- Universal clamp assures positive contact in either direction.
- High-conductivity copper alloy . . . resists corrosion.
- Everdur U-bolt can be clamped in place on rod or pipe and ground cable fastened as a secondary operation.
- Each fitting accommodates a wide range of wire sizes.

TYPE CG

More and more electrical wholesalers are stocking O. Z. fittings. See your local distributor today. Write us for catalog detailing sizes, features, and prices of the complete O.Z. line.

2024

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • SOLDERLESS CONNECTORS
GROUNDING DEVICES • POWER CONNECTORS

O.Z. ELECTRICAL MANUFACTURING COMPANY
262 BOND STREET · BROOKLYN, 2 N. Y.

An announcement of importance to the

ELECTRICAL INDUSTRY

COLE Federal NOARK WW

Federal Electric Products Company announces the acquisition of one of America's oldest and best known manufacturers of switchboards and panelboards,

WM. WURDACK ELECTRIC MANUFACTURING COMPANY
St. Louis, Mo.

With the addition of the superb plant facilities, engineering and sales organization of this fifty year old company, Federal takes an important step forward in its expansion program, and places itself in a much improved position to render service to its customers.

In addition to this acquisition, the Cole Electric Products Company, Inc., long affiliated with Federal, and an outstanding manufacturer of custom built electrical apparatus, is also being merged into the greater Federal organization.

Out of this greatly expanded organization comes a new competence unsurpassed in the industry for the rendering of production and engineering service covering every phase of electric light and power distribution.

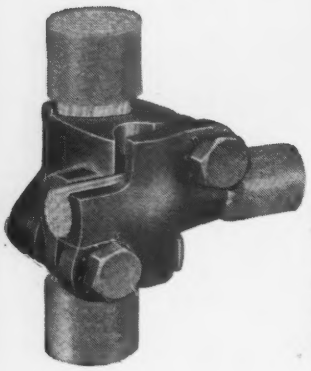
FEDERAL ELECTRIC PRODUCTS COMPANY

Executive Offices: 50 Paris Street, Newark 5, N. J.

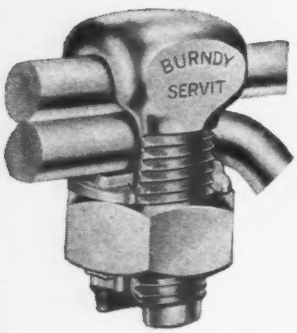
Factories: Newark, N. J., Hartford, Conn., St. Louis, Mo., Long Island City, N. Y.

A Complete Connector Service

BURNDY



VERSITAP Type QPX— Extremely versatile, for end-to-end, cross, parallel or T connections. High-strength, vibration-proof. Ten sizes for cables #6 to 1000 Mcm.



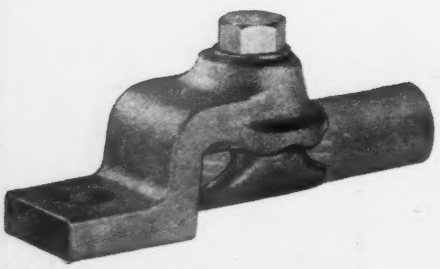
SERVIT Type KS — Highly popular, used for taps, dead ends, service entrances, motor leads, junction boxes, etc. Thirteen sizes for conductors from #10 wire to 1000 Mcm.

QIKTAP Type QT — A compact T connector. High compression contacts enforced by large bolts and nuts. Withstands severest vibration. Available for all combinations of cables.

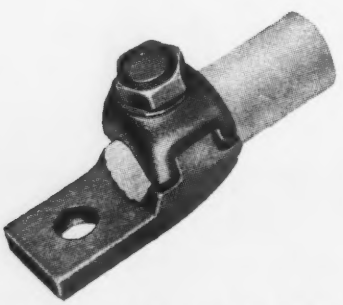
SOLDERLESS Electrical Connectors for industrial buildings, power stations or substations; for overhead or underground; construction or maintenance; for copper or aluminum, cable, bar or pipe. Burndy has engineered thousands of electrical connectors. There is one best connector for your next connection and Burndy has it.

Write for Catalog 41 for the proof —

BURNDY NewYork 54, N.Y.



VERSILUG Type EA — Sturdy clamp-type lug with clamp element adjustable to seven angles. Installs with ordinary wrench. Six sizes for conductors from #8 wire to 1000 Mcm. Supplied with 1, 2, or 4 holes in tongue.



QIKLUG Type QA-B — Withstands high vibrational strain, installs with ordinary wrench. Available with 1, 2, or 4 holes in tongue. Multiple and special types on request. Available for conductors from #14 solid to 500 Mcm.

SCRULUG Type KPA — Low cost, compact, pressure connector having high conductivity. Small size installed with screw driver, large size with ordinary wrench. Available in five sizes for conductors from #14 solid to 500 Mcm.

LABOR DAY • 1946
—Time for wise union leadership

LABOR DAY, 1946, finds one hopeful element in the relations between American management and labor which was not there on Labor Day, 1945. It comes in recent expressions by a number of national leaders of organized labor that increased "real" wages depend upon *increased productivity,* i.e. increased output per man-hour. Increased money wages which are promptly offset by higher prices do nobody any good.

If these expressions, *which still remain to be substantiated by practical performance,* come to be accepted by the rank and file of labor in each community, Labor Day, 1946, can usher in a period of great and perhaps unprecedented improvement in the economic wellbeing of wage earners — as well as the wellbeing of the country at large. If, on the contrary, they remain merely window dressing and there is a continuation of the post V-J Day process of increasing wages and then prices, the outcome can only be the bursting of an inflationary bubble, with attendant suffering for workers and the community generally.

Competition requires management to bear down heavily on increased labor productivity as a prelude to wage increases. Management, however, has rarely made a more forthright statement on the importance of increasing labor productivity than that contained in a recent issue of LABOR'S MONTHLY SURVEY, an official publication of the American Federation of Labor.

William Green, the Federation president, led off with a "message to American workers." He remarked, "Our major need is increased volume of production." Observing that "wage increases this spring have been paid for by raising prices," the survey itself goes on to say that "Today America's ability to raise wages without increasing prices and living costs depends on increasing productivity in civilian industries . . . Here is the challenge to free labor and free enterprise today: *Cooperate to increase productivity and raise living standards without strikes.*" (Italics supplied.)

The importance of increasing production was also recently stressed by Walter Reuther, President of the United Automobile Workers, C.I.O., who remarked that his union "is just as eager as management to get the (automobile) industry into maximum production." In taking this general line he was in accord with the position of Philip Murray, head of the C.I.O., who in a book, "Organized Labor and Production" written with Morris L. Cooke, remarks that, "The modern labor leader also realizes that to receive a good day's pay a man must do a good day's work and that *increased productivity has been the vital factor in the country's industrial supremacy and its relatively high wage scale.*" (Italics supplied.)

In citing increased productivity as the key to increased "real" wages these labor leaders—and management — have the historical record entirely on

SPOT CHECK ON LABOR OUTPUT

In the absence of reliable general statistics on what has happened to productivity of labor since V-J Day (because of strikes and reconversion complications) the McGraw-Hill Publishing Company asked the executives of a cross section of American industry to report their own impressions. The questions asked and summaries of the replies, which varied markedly from industry to industry and plant to plant, follow.

Question No. 1. How well have workers performed since V-J Day as compared to their pre-war effort?

Answer. Worker effort has been below pre-war. There are exceptions, particularly among older and more experienced workers; and there are quite a few signs of improvement.

Question No. 2. How much headway have you been able to make since V-J Day in improving labor productivity by better equipment and organization?

Answer. Some headway is generally being made, but it has been greatly retarded by inability to get new equipment and, in some cases, by lack of labor cooperation in improvements in organization.

Question No. 3. How much improvement in equipment and organization is to be anticipated in your business over the next year?

Answer. Marked improvement in productivity (in a few cases as much as 20 per cent) can generally be made if there is sustained production and full cooperation between labor and management.

their side. In the 40 years prior to the outbreak of World War II output per man-hour for the country as a whole was approximately doubled. Over the same period the "real" hourly earnings of industrial workers were also approximately doubled. There were, of course, great variations in the increase of output per man-hour from one line of activity to another. Also, there were periods when increases in "real" wage rates lagged behind increases in productivity. But for the 40 year period as a whole and the economy as a whole there is no mistaking the fact that the route to increased "real" wage rates was increased productivity.

Three economic factors played major roles in this doubling of production per man-hour which has made America the industrial marvel of the modern world. One was the skill and diligence of American workers. A second was the skill and diligence of American management in organizing production. A third was the improvement of machinery and the increased application of power to it.

Wartime Record

During World War II this sustained increase in the productivity of labor in *civilian* manufacturing industries, which had averaged about 3 per cent a year, was brought to an abrupt halt. Much of the most efficient segment of the nation's labor force went to war or war industry. Also, civilian industry was starved for new equipment while we equipped our arsenals. The result was that the productivity of labor in those civilian manufacturing industries for which the government keeps records actually declined throughout most of the war. By 1945 it was no higher than in 1941, whereas, if it had maintained the long run average, it would have been about 12 per cent higher. In the meantime, however, average hourly wages in these civilian industries had increased about 40 per cent.

In *war* industry, which started from low levels of production at strange tasks, there were substantial increases in output per man-hour. Many of these increases involved new processes, improved techniques, and better machines which can be adapted over a period of time to the improvement of productivity of labor in civilian industry.

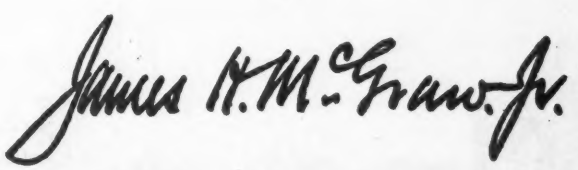
Since V-J Day, however, labor, led on by a misguided government, has had its sights on higher money wages instead of improving productivity which would have laid the foundation for increased "real" wages. Consequently, debilitating industrial strife ended in a round of wage increases which, in the absence of increased productivity, is being washed out by higher prices.

To Keep Production Rolling

However, as indicated by the summary of a McGraw-Hill sampling of the current experience of industry in increasing output per man-hour, which appears in the center of the page, there is hope that the situation ahead can be improved. After agonizing delays because of work stoppages, material shortages, and reconversion complications, industrial production is beginning to roll again. Allowed to roll it will not be long before it will be making those advances in productivity which are the only true basis for increased "real" wages.

If the process of keeping American industry rolling to new highs of productivity is to be resumed, management must see that the past practice of translating increased output per man-hour into increased "real" wages is not only sustained but wherever possible accelerated. For its part organized labor must abandon its manifold feather bedding rules and other production-restricting practices which afflict considerable segments of American industry. Further it must give incentive systems of pay, honestly conceived and honestly administered, a fair break. *Management and labor and government and the community at large must collaborate in removing that specter of working one's self out of a job which has been one of the greatest causes of restriction of output.*

The current emphasis by leaders of organized labor on the economic truth that increased output per man-hour is the only road to increased "real" wages is important. The next step is to see that recognition of this truth seeps into the rank and file of labor and industry and becomes the basis of a program of action at the local level. If it does, and quickly, Labor Day, 1946, may mark a tremendous turning point toward sustained prosperity not only for labor but the community at large. If it does not, union leadership will fail in its responsibility and must answer to the American people for the consequences of such a failure.



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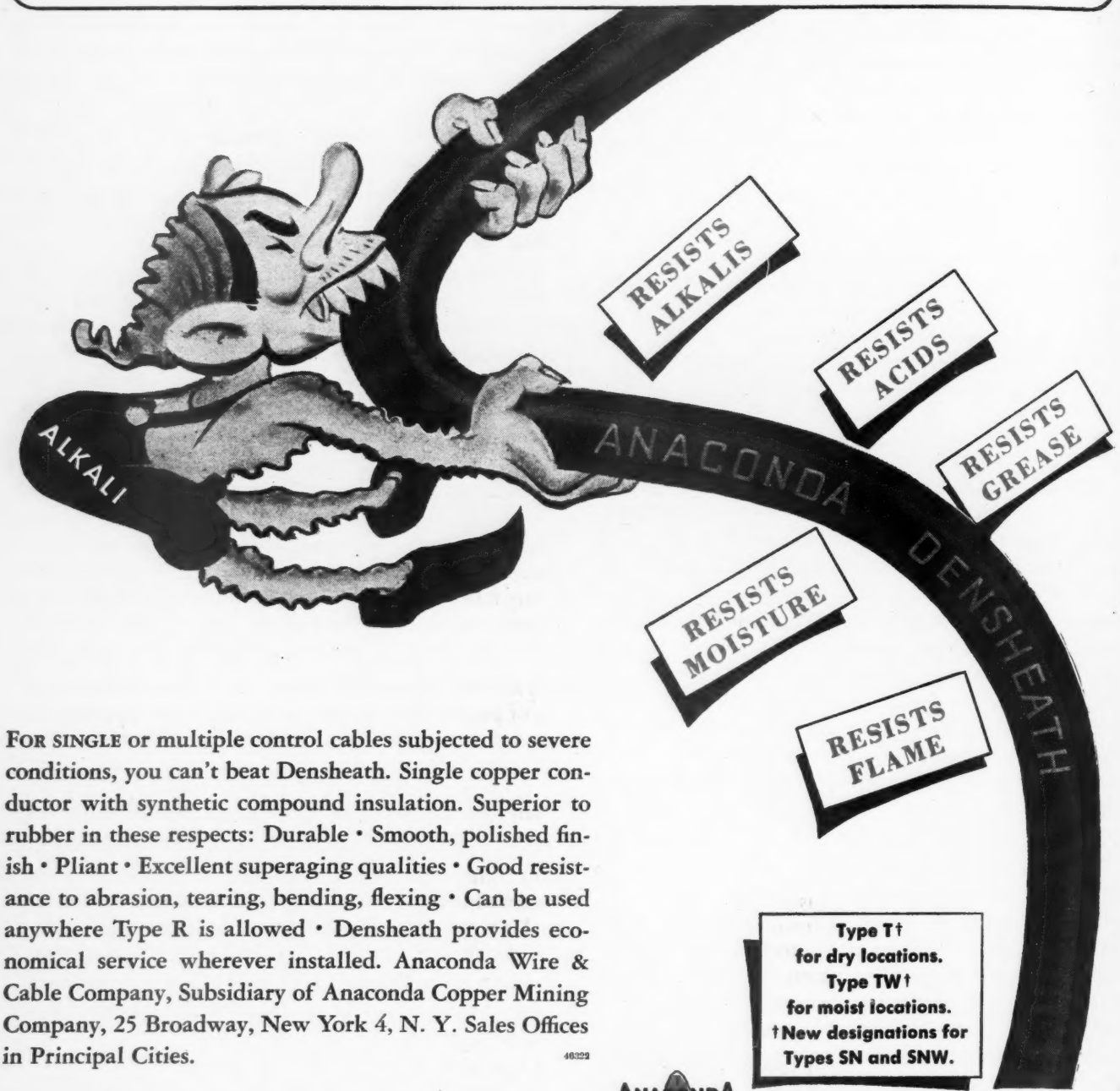

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SPECIFICATIONS

WITH THE POSSIBLE exception of his income tax instructions, there is probably no other printed matter the electrical construction man reads so earnestly as job specifications. From the preliminary estimate to the final payment the specification is subjected to constant reference in many hands. It is equally at home on the executive desk or weighted to a loose tile by a set of old dies at the current frontier of the roughing-in crew.

AS A RULE, the job specification is conspicuous for its Spartan austerity in binding, typography and paper. The content is no more appealing. Paragraphs are blunt, brief and imperative. Like a traffic summons, each impels to certain action within a time limit.

BUT WHATEVER it may lack in elegance of format or phrase, it issues the orders which men carry out to create structures of great beauty and usefulness. The job specifications of a home may have a traceable effect on the lives and ways of a family through several generations. The job specifications of a library may affect the lives of folks in a community more immediately than any of the classical literature the finished structure houses.

SPECIFICATIONS are written and read solely as a guide to action and, as such, they influence the lives of people. This is particularly true of electrical work. Well wired buildings invite and stimulate the development and use of electrical devices, appliances and conveniences for better work and better living. Poorly wired buildings impede and eventually halt the progress of electrical utilization. The choice is often in the hands of the man who writes the specification.

EVERYONE WHO writes, develops or applies electrical specifications has, therefore, a burden of responsibility which goes beyond the immediate job and its connected load. He must see his work as a part of a living community and a growing technology. Final inspection finishes the job but only begins the life and usefulness of the building.

IN THIS ISSUE, the biggest in our 45 years of publication, we have brought together a master electrical specification. We hope it will be useful. We hope it will contribute to better job specifications, and through them, to better electrical work today and tomorrow.

Wm. F. Stuart

Electrical Contracting—SEPTEMBER, 1946

EVERYTHING

2.1 SERVICE ENTRANCES

Busduct . . . service-entrance switch panels . . . cable . . . fittings

2.2 GROUNDING

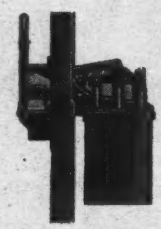
Ground rods . . . grounding fittings . . . ground wire

3.1 SUBSTATIONS AND VAULTS

Transformers . . . switchgear . . . meters . . . testing

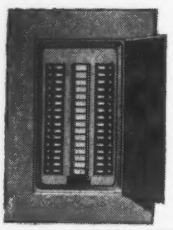
4.1 SERVICE SWITCHES

Circuit breakers . . . knife switches . . . protective devices



4.2 PANELS AND CABINETS

Panelboards . . . fuses . . . telephone cabinets . . . pull boxes . . . switchboards



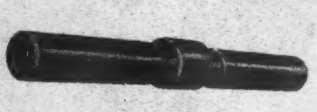
5.1 FEEDERS

Bus feeder . . . conduit . . . cable . . . fittings

5.2 BUS BAR DISTRIBUTION SYSTEMS

Enclosed bus bar distribution systems . . . bus drop cable . . . fittings

5.3 UNDERGROUND DISTRIBUTION SYSTEMS



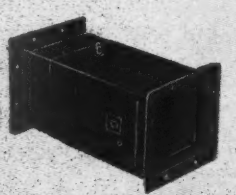
Fibre conduit . . . clay conduit . . . low- and high-voltage cables . . . tools . . . potheads

6.1 BRANCH CIRCUITS

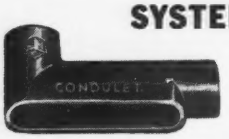
Circuit wire . . . conduit . . . fittings

6.2 SPECIAL RACEWAY SYSTEMS

Every type of raceway system for any installation



6.5 EMERGENCY AND AUXILIARY WIRING SYSTEMS



Cable . . . fittings . . . conduit . . . raceway systems

7.1 SIGNAL AND COMMUNICATION

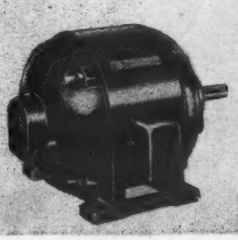
Every type of signaling system for office, factory or institution

8.1 LIGHTING COMPONENTS AND FIXTURES

Graybar has most complete selection of lamps and lighting units . . . universal Trol-E-Duct

8.2 APPARATUS AND EQUIPMENT

Fractional-hp. and integral-hp. AC and DC motors . . . controls . . . electronic and heating equipment



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ELECTRICAL SPECIFICATIONS

A manual of specification procedure and development for modern electrical construction with typical specification paragraphs.

GOOD specifications are essential to good construction. Together with the plans, they form the contract documents. As the plans show "where" and "how much", so the specifications must tell "what", "when", and "how".

This is especially important in electrical work. In no other major craft is there so much of such a variety of factory-made material involving highly technical qualities. No other craft requires such a range of skills and know-how in installation and workmanship. Though electrical work involves only a small portion of total construction costs, it is vital to useful occupancy. It is often the most critical measure of whether a structure is modern or obsolete. The quality of materials, the adequacy of layouts and the excellence of workmanship in electrical work have a critical relationship to building value and usefulness far exceeding the moderate cost differences between good and poor practice. Electrical work, therefore, deserves good specifications which will clearly establish performance in keeping with the purpose, use and expected life of the structure.

In the following pages we have brought together a master electrical specification which is intended to provide the framework and, to a large extent, the substance of a "good" specification. It is designed for maximum usefulness to the contractor, engineer or architect who must, in the course of his work or profession, write or develop electrical specifications.

Material and guidance have been drawn from many sources including Federal and State specifications, and the specification of several leading architects and engineers. The work has been prepared and developed by the editors with the collaboration of Ray Ashley, Consulting Electrical Engineer. All are men with many years of practical experience with electrical specification and the execution of electrical contracts.

It has been necessary, for clarity and simplicity, in a number of instances, to specify a particular material where some manufacturers may use other materials of equal or superior quality for the purpose. For instance an outlet box specified as galvanized sheet steel might for the purpose be equal or better if made from aluminum, cast iron or other material. It is presumed that the reader is sufficiently familiar with materials and practices to recognize these limitations and in his own specifications change or expand the range of materials to include alternatives suitable for particular jobs.

Where there are several alternative methods or materials we have given the more common ones. In such instances those given do not necessarily exclude other practical methods.

Master specification paragraphs are prepared in conventional specification language so that they may be transcribed directly into working specifications with little editing or revision. They are edited, however, for clarity and brevity without special regard for legal phraseology or elegance of style.

No master specification can take the place of competent engineering, well executed plans, or experienced design and layout. No more can they, however tightly written and enforced, eliminate the necessity for contracting with firms of known worth, skill and experience. Contractors, engineers, architects and others concerned with specification writing or with detailing more broadly written specifications of others will find this master electrical specification a useful check on present practice, a source for expanding, rewriting or bringing up-to-date their own standards and a means of clarifying proposals and bids.

Though we have been conscientiously fair and unbiased with respect to manufactured materials, preferences for particular brands and qualities are the very essence of good specifying. From the architect who, at the professional level, writes a performance specification around a product he knows and respects, to the contractor who must eventually convert his preferences into specific names and catalog numbers on the purchase order, product preference eventually establishes the quality and characteristics of the electrical job. So the work of the manufacturers who display and describe their products, and who seek to establish their special worth or superiority, must be considered an important and most useful part of this Specification.

TABLES

1.1 GENERAL CONDITIONS

The material in the following pages is indexed by a decimal method which allows wide flexibility for including other specification material the reader may want to add.

Paragraphs which appear in light face type are explanatory. Paragraphs in bold face type are specifications and are written in specification style. They are generalized by dashes or typical paragraphs which may be easily edited to fit particular jobs.

General conditions: The General Conditions of the Contract as published by the American Institute of Architects is recommended as the basis for this part of the specification. The following index indicates the subjects:

1. Definitions.
2. Execution, correlation and intent of documents.
3. Detail drawings and instructions.
4. Copies furnished.
5. Shop drawings.
6. Drawings and specifications on the work.
7. Ownership of drawings and models.
8. Samples.
9. Materials, appliances, employees.
10. Royalties and patents.
11. Surveys, permits and regulations.
12. Protection of work and property.
13. Inspection of work.
14. Superintendence: supervision.
15. Changes in the work.
16. Claims for extra cost.
17. Deductions for uncorrected work.
18. Delays and extension of time.
19. Correction of work before final payment.
20. Correction of work after final payment.
21. Owner's right to do work.
22. Owner's right to terminate contract.
23. Contractor's right to stop work.
24. Applications for payments.
25. Certificates of payments.
26. Payments withheld.
27. Contractor's liability insurance.
28. Owner's liability insurance.
29. Fire insurance.
30. Guaranty bonds.
31. Damages.
32. Liens.
33. Assignment.
34. Mutual responsibility of contractors.
35. Separate contracts.
36. Subcontracts.
37. Relations of contractor and subcontractor.
38. Architect's status.
39. Architect's decisions.
40. Arbitration.
41. Cash allowances.
42. Use of premises.
43. Cutting, patching and digging.
44. Cleaning up.

Subjects particularly applicable to electrical installations follow, the numbers indicate where they may be inserted in the above index.

2. Scope of these specifications

The work to be done under these specifications shall include the furnishing of all labor and material required to complete and leave ready for operation the installation of the following items, in accordance with these specifications and the accompanying drawings:

(List here each system that is to be included in the electrical contract, such as wiring for lighting; power; special systems—radio, telephones, paging, etc. If only installation labor is required for certain work, so state.)

3 Drawings

These specifications are accompanied by floor plans of the building showing the location of all outlets and the switch control,

a. the layout of the branch circuits

b. (and) a riser diagram.

The drawings and these specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

9. Standards for Material and Workmanship

All materials shall be new and shall conform with the standards of Underwriters' Laboratories, Inc., in every case where such a standard has been established for the particular type of material in question. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance when completed.

11. Codes, Permits and Inspections

The installation shall comply with all laws applying to electrical installations in effect, with the regulations of the National Electrical Code where such regulations do not conflict with the laws in effect, and with the regulations of the public utility company furnishing the electric service.

(In localities where electrical installations are governed by municipal ordinances.) The contractor shall obtain all permits required by the ordinances of the city of ..... and after completion of the work shall furnish to the owner or architect a certificate of final inspection and approval from the electrical inspection department of the city of .....

(In localities where no ordinance governing electrical work is in effect.) After completion of the work the contractor shall furnish to the owner or architect a certificate of final inspection and approval from the Underwriters' Inspection Bureau having jurisdiction.

30. Guarantee

The contractor shall leave the entire electrical system installed under this contract in proper working order and shall, without additional charge, replace any work or material which develops defects, except from ordinary wear and tear, within one year from the date of the final certificate of approval issued by the inspection department.

When a part of the electrical system is placed in service prior to the date of final approval, that particular system or partial system shall then commence its one-year period of guarantee. This guarantee shall expire one year after such systems or partial systems are placed in service, without regard to the date when the final certificate of approval covering the entire system is granted.

1.3 Procedure

Plans and specifications should provide a clear description of the work. They should be free of ambiguity and should limit the range of alternative materials or methods to definite commercial quality standards.

• • •

1.31 Industry standards: The following industry standards shall be considered as minimum requirements.

The standard rules of the American Institute of Electrical Engineers; The Rules and Regulations of the National Board of Fire Underwriters (National Electrical Code); The National Electrical Manufacturers Association Standards; The Insulated Power Cable Engineers Association; National Bureau of Standards; National Electrical Safety Code; and the Rules and Regulations of the Local Utility.

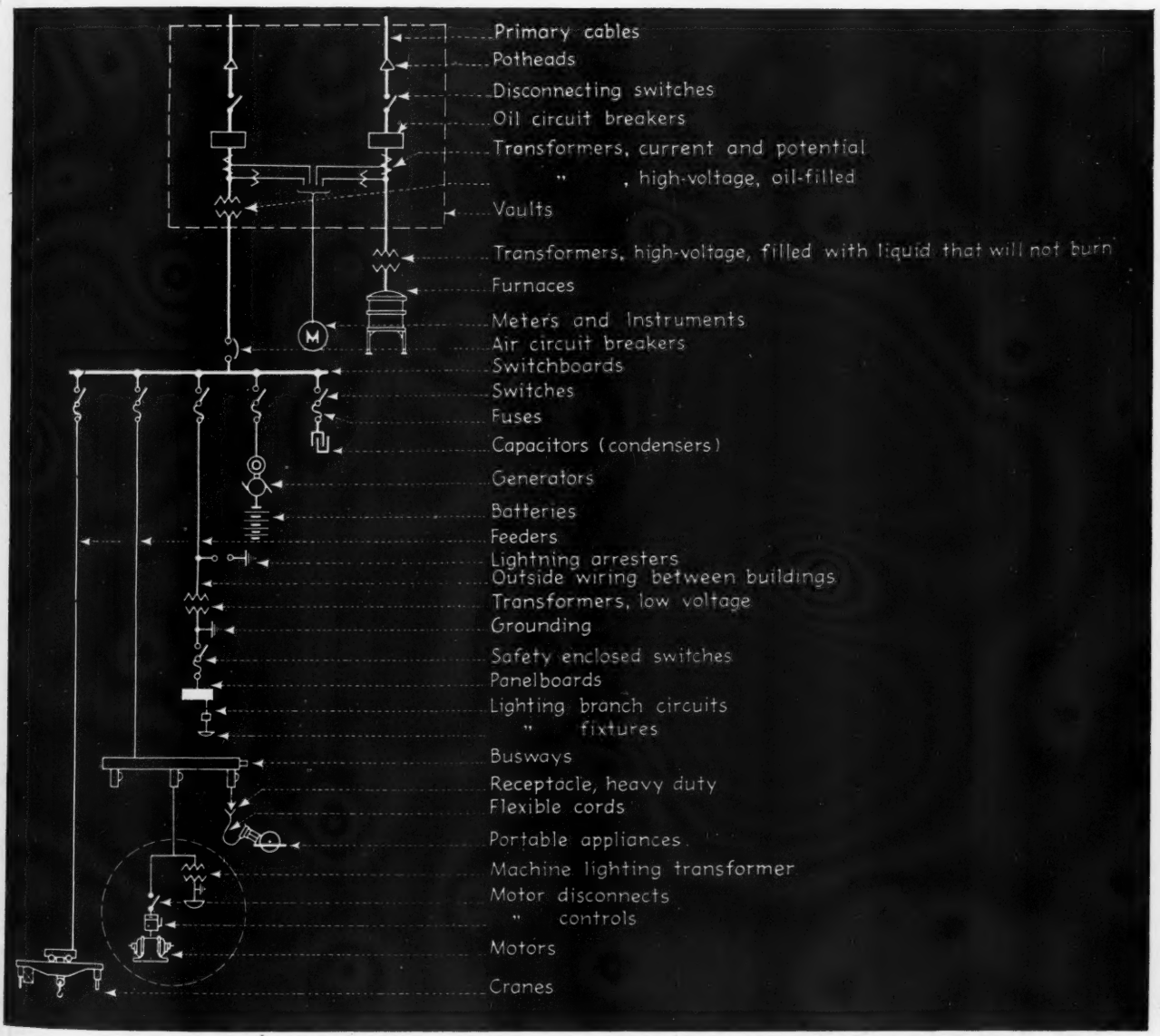
• • •

1:32 Drawings: The following drawings accompany this specification and are hereby made a part thereof.

No.	Title
E 1	Plot plan and underground feeders.
E 2	Riser diagram
E 3	First floor plan
E 4	Second floor plan
E 5	Fixture details
E 6	Service entrance details

The drawings and their specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

When the building plans are not too complex, and not too densely traced with structural details, all electrical outlets and wiring may be indicated thereon. A separate tracing of each floor devoid of details not essential to the electrical work is recommended for the preparation of most wiring plans. A feeder or "riser" diagram should also be made where there are three or more feeders. These riser diagrams may include schematic explanations of special systems, such as private intercommunicating telephones, stairway controls, remote controlled motor details, etc.



Elements of an industrial electrical installation in conventional diagram symbols. A guide for preparing one line system layouts.

The wiring plans, and general plans as well, should show at their locations all outlets, switches, motors, controllers, auxiliary electrical equipments, panelboards, service equipment, and such special system outlets as signals, telephones, clocks, exit lights, etc. The wiring plans should show the completed wiring details which are in most cases too complex to indicate clearly upon detailed structural plans.

The steps to follow in preparing the wiring plans are:

Initial space provisions: Obtain tentative location and type of service, especially if current is to be supplied by the power company, based on the approximate demand for the building. Assign liberal spaces and clearances to accommodate service raceways, service equipment, transformer station, and main distribution center. Final details can be determined only after the layout is completed and the load has been computed.

Lighting layouts: Locate and mark by standard symbol

STANDARD SYMBOLS FOR ELECTRICAL EQUIPMENT OF BUILDINGS

- Ceiling Outlet
- Ceiling Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain
- Ceiling Outlet for Extensions
- Ceiling Fan Outlet
- Floor Outlet
- Drop Cord (D)
- Wall Bracket
- Wall Outlet for Extensions (E)
- Wall Fan Outlet
- Wall Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain. (R)
- Single Convenience Outlet
- Double Convenience Outlet ($_2$)
- Junction Box (J)
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Exit Light
- Floor Elbow (^{E})
- Floor Tee (^{T})
- Pull Switch (P.S.)
- Local Switch—Single Pole (S^1)
- Local Switch—Double Pole (S^2)
- Local Switch—3 Way (S^3)
- Local Switch—4 Way (S^4)
- Automatic Door Switch (S^D)
- Key Push Button Switch (S^K)
- Push Button Switch and Pilot (S^P)
- Remote Control Push Button Switch (S^R)
- Tank Switch (T.S.)
- Motor
- Motor Controller (M.C.)
- Lighting Panel
- Power Panel
- Heating Panel
- Pull Box
- Cable Supporting Box
- Meter
- Transformer
- Branch Circuit, Run Concealed under Floor Above
- Branch Circuit, Run Exposed
- Branch Circuit, Run Concealed Under Floor
- Feeder Run, Concealed under Floor Above
- Feeder Run, Exposed
- Feeder Run, Concealed under Floor
- Pole Line
- Push Button
- Buzzer
- Bell
- Annunciator
- Interior Telephone
- Public Telephone
- Local Fire Alarm Gong (F)
- City Fire Alarm Station
- Local Fire Alarm Station (F)
- Fire Alarm Central Station (F.A.)
- Nurse's Signal Plug (N)
- Horn Outlet
- District Messenger Call
- Clock (Secondary)
- Clock (Master)
- Time Stamp
- Electric Door Opener
- Watchman Station (W)
- Watchman Central Station Detector (W)
- Public Telephone—P. B. X. Switchboard (P.B.X.)
- Interior Telephone Central Switchboard (I.X.)
- Interconnection Cabinet
- Telephone Cabinet
- Telegraph Cabinet
- Special Outlet for Signal System as Described in Specification.
- Battery
- Signal Wires in Conduit Concealed Under Floor
- Signal Wires in Conduit Concealed under Floor Above
- This Character Marked on Tap Circuits Indicates 2 No. 14 Conductors in ½-in. Conduit (see note)
- 3 No. 14 Conductors in ½-in. Conduit
- 4 No. 14 Conductors in ¾-in. Conduit Unless Marked ½-in.
- 5 No. 14 Conductors in ¾-in. Conduit
- 6 No. 14 Conductors in 1-in. Conduit Unless Marked ¾-in.
- 7 No. 14 Conductors in 1-in. Conduit
- 8 No. 14 Conductors in 1-in. Conduit

NOTE.—If larger conductors than Number 14 are used, use the same symbols and mark the conductor and conduit size on the run.

all (1) lighting outlets, (2) convenience, appliance, heavy-duty or other special outlets, (3) local or multi-location switch controls (trace in to outlets they control), (4) lighting panelboards. Determine circuit distribution, interconnect outlets, and assign circuit numbers. Where the wire is larger than No. 12, show the size, the number of wires per run, and the size of raceway to be used.

Power layouts: Locate and mark by standard symbol all (1) motors, (2) controllers, (3) stationary heating devices, (4) remote control and auxiliary control devices, (5) power panelboards. Determine branch circuit distribution, wire and raceway size, and assign circuit numbers.

Where any considerable number of motors is to be wired for, the location of each motor and other power equipment, such as heaters, should be shown on the plans, also showing the hp. or kw. rating, the kind of machine driven and the location of the controller. It is well to assign a number to each motor and to prepare specification sheets giving for each motor or heater its number, location, hp. or kw. rating, description of machine driven and type of controller to be used.

Auxiliary system layouts: Locate and mark by standard symbol, all (1) auxiliary system outlets, such as telephones, gongs, annunciators, etc., (2) junction or terminal cabinets, (3) batteries, transformers, or other power supply sources. Determine circuit routing or subdivision, indicate on plans and riser diagram, and provide for panelboard circuits to supply auxiliary systems.

Circuit runs: For concealed work in fireproof construction, circuit runs should as far as possible be shown as straight lines from outlet to outlet. For concealed raceway work in wood joist construction, right angle bends must as a rule be used and it is preferable to lay out the work in such manner as to indicate such bends on the wiring plan. For exposed work the approximate actual position of the runs should be shown.

Abusive or hazardous area design: Isolate or place in a separate room wherever possible all equipment the safe or successful operation of which would be affected by (1) abrasive metals, dusts and chips, (2) condensation, (3) corrosive atmospheres, (4) excessive temperatures, (5) grease and oil, (6) excessive vibration, (7) water drippage or splashing, (8) explosive dusts or fumes, (9) ignitable fibres, flying or accumulations, (10) flood waters. Provide sealing fittings in raceways leading to rooms of widely different temperatures, to prevent air circulation and condensation within such raceways.

Final calculations: Calculate, route and indicate on plans and riser diagram the complete feeder system, main distribution equipment, and service equipment.

Tracing methods: In addition to using standard wiring symbols, the wiring plan tracings will be more easily checked in the office during the progress of design, during construction, or in case of revisions, by employing various colors of tracing ink to distinguish between lighting, power, signal, telephone, fire alarm or other special systems.

To prepare complete wiring layouts, various standards, recommendations, or engineering data, are needed for determining loads, number of outlets, controls, or routing of circuits.

The data tables in section 9.1 will provide much of the basic information necessary.

Lighting outlets: In many cases, particularly in industrial plants, either the various classes of work to be done have not been assigned to definite spaces in the building when the wiring layout is made, or there is a probability that at some future time machines and other equipment will be relocated. In all such cases, wiring capacity should be provided that will be sufficient for the maximum probable need.

The first step in laying out a wiring system is to determine the outlet locations and loads.

As the architectural features of the room or space become more important, the choice in the location of outlets becomes more and more restricted. Extreme cases are churches, theatres and similar buildings of somewhat elaborate architectural treatment, where the lighting equipment, whether concealed or exposed, must be located so as to fit properly in its surroundings, otherwise the effect is crude and displeasing. Similar conditions may be met in some retail stores, hotel and office building lobbies, lodge halls, libraries, banking rooms, etc. At least a preliminary design of the lighting system should be made in these cases before the wiring is laid out.

Any space that is to be occupied as an office in an industrial building is to be treated as an office, while a workshop in a commercial building is to be treated as an industrial occupancy.

Incandescent lighting loads: To determine the wattage loads after the outlets have been located, take the watts per square foot required, for the given case multiply this figure by the total area of the space, in square feet, to find total watts. This result divided by the total number of outlets gives the computed watts per outlet.

Example: A retail store sales room measures 45 ft. by 96 ft. and there are 18 ceiling outlets. Single-lamp fixtures are to be installed. What is the proper wattage per outlet? The standard load is 4 watts per sq. ft.

$$45 \text{ by } 96 = 4320 \text{ sq. ft. total area}$$

$$4{,}320 \text{ by } 4 \text{ watts} = 17{,}280 \text{ watts}$$

$$\frac{17{,}280}{18} = 960 \text{ watts per outlet}$$

This wattage should then be adjusted to 1000, this being the nearest commercial lamp rating.

In those cases where an illumination system has been designed and specified to produce values of illumination intensity lower than the maximum values referred to above, the wiring layout nevertheless should be based upon the standard lighting load tables.

If no occupancy corresponding to the given case is listed in the tables, a preliminary illumination design will determine the required watts per outlet.

Fluorescent lighting loads: To determine loads required for fluorescent lighting an illumination design must be prepared for typical areas and the watts per square foot determined for each type of lighting application. For instance a school project would require a class room layout, auditorium layout, corridor layouts, etc. In each case the watts per square foot required would then be applied to all similar areas in the building.

Convenience outlets: In retail stores the use for which convenience outlets are intended should be carefully considered. The general recommendation is not over six outlets per circuit but in many cases this number should be reduced. Only one outlet per circuit may be desirable in certain cases.

Outlets for show window lighting should usually be located on the sides of the columns, at or near the height at which the lighting equipment is to be located.

Floor outlets for show case lighting should be located from final plans showing the exact locations of the store fixtures. In a small store having an unfinished basement, circuits may be carried down from the cabinet to a junction box in the basement. These circuits may be run to the desired locations after the fixture locations have been determined.

Outlets for wall case lighting can usually be located in the wall so as to be just above the cases. Wiring can then be extended on the tops of the cases to the lighting equipment. Where display cases back of the counters and on the column lines are to be lighted, outlets may be located on the column just above the cases, or if this is not feasible, floor outlets must be provided.

Lighting branch circuits: Having determined the outlet location and the watts per outlet, or outlets per circuit, the number of branch circuits should next be determined. It is preferable to make a final check by laying out the circuits on the floor plans. The number of circuits for general illumination is determined from the outlet wattage, and the usual limit is 1000 watts per circuit.

Heavy-duty branch circuits: Where the entire load on a circuit consists of mogul-base lamps or mercury-vapor lamps, special high capacity circuits may be used. These are known as "heavy-duty circuits." These circuits may consist of No. 12, No. 10, or No. 6 wire, with overcurrent protective devices rated or set at 20 amp., 30 amp., or 50 amp., respectively.

For mogul-base incandescent lamps, these high capacity circuits should be so laid out that the initial load may be increased by substituting lamps of the next larger size. Circuits of No. 12 wire need not be considered because with this size the voltage drop would be excessive unless the circuits are very short. For circuits of larger wire the initial loading should not exceed 1500 watts for No. 10, nor 3000 watts for No. 6.

A 15 amp. circuit should not exceed 1000 watts initial, hence for any higher wattage it is necessary to use heavy-duty circuits if single-lamp fixtures are to be used. Thus if each bay measures 18 ft. by 20 ft. and 4 watts per sq. ft. is required, with one outlet in the center of each bay, the wattage per outlet is 360 x 4 = 1440 watts. For single-lamp fixtures a heavy-duty circuit of No. 10 wire or larger should be run to each outlet, or No. 8 or No. 6 wire may be used with two outlets per circuit.

Voltage drop: The voltage drop on lighting branch circuits should preferably not exceed 2 percent. It is not practical to calculate the wire size for every circuit, because too much time would be required to make the calculations, and in order to avoid unnecessary complication it is better to use not more than two sizes of wire.

A sufficiently close approximation to the desired voltage drop will be obtained by following the rules for wire sizes and voltage drop.

Receptacles must have a rating not less than the load they serve and when connected in branch circuits must be rated as follows:

15 amp. circuits —	not over 15 amp. rating
20 amp. circuits —	20 amp. rating
30 amp. circuits —	20 or 30 amp. rating
50 amp. circuits —	50 amp. rating

Exception permits medium base lampholders on 20 amp. circuits where only fixed lighting equipment is served, 15 amp. receptacles on 20 amp. circuits supplying only small appliances as in the dwelling appliance circuit.

Motor and heating device outlets: The size and type of motor or heating device to be indicated on the plans is nearly always determined by specific units of mechanical equipment. Therefore, the discussion with respect to design procedure for power wiring must be based on the assumption that such equipment has been definitely selected before wiring plans are prepared.

Outlet locations: In most cases the location of machinery such as pumps, compressors, elevators, blowers, etc., is fixed because of structural or other important mechanical design features. Therefore, the motor or heating device location is largely dictated by the machinery location.

Controller locations: Particular care must be given to locate control equipment for maximum accessibility, to save steps, and to isolate it from mechanical injury or deterioration from dripping water, vapors, etc. To meet one or more of these conditions often necessitates a carefully chosen controller location at a remote out-of-danger place. Therefore one or more remote-control pushbutton stations are usually located nearby or upon each machine. In addition various auxiliary combinations of limiting switches or tripping devices may be selected or may already be included as integral machine equipment. The wiring plans should indicate clearly the locations of such controlling devices and the raceway routings to be followed when wiring connections are not already provided for them on the machine.

In grouping at one location two or more assemblies of controllers, disconnecting switches, resistors, and other auxiliary devices, show on wiring plans such details as are necessary to assure the fabrication of supporting frameworks and the proper alignment or positioning of raceways to meet exacting requirements.

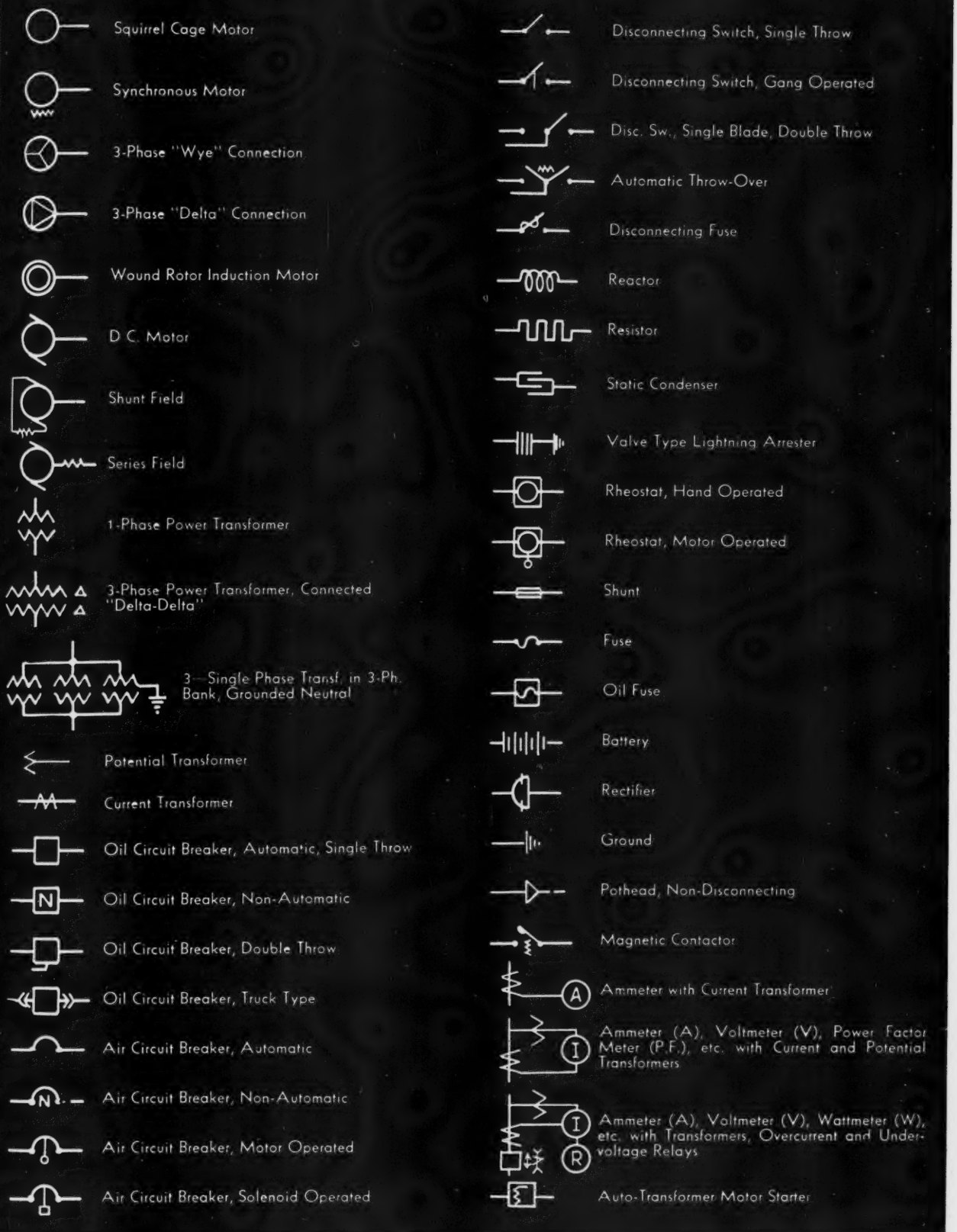
To determine the detailed requirements for motor controllers and their disconnecting means see Article 430 of the National Electrical Code. Where a motor controller is not located within sight of its motor, the controller must usually be capable of being locked in the open position. A manually operable switch designed to prevent the starting of a motor may be located within sight of remote controlled motors. This switch may be placed in the remote control circuit of the remote control switch or switches, or it may disconnect the motor branch circuit conductors.

Branch circuits: Wiring connections should indicate (1) whether raceways are to be run concealed or exposed between the motor or heating device and its control equipment, (2) whether run overhead or on the floor, and

(3) the exact location for terminating the raceway beside the motor.

Many motors and heating devices, as for printing press and laundry equipment, are mounted on machines with or without machine-mounted controllers. For such cases, particularly in concealed home-runs, the wiring plans should indicate the exact raceway termination at each machine. When a machine is supplied with all its wiring

SYMBOLS COMMONLY USED FOR ONE LINE WIRING DIAGRAMS



installed by the manufacturer, state this condition, whereas the complete details of all wiring that is to be attached to machines by the wiring contractor should be indicated on the wiring plans.

For motors or heating devices that are located in areas having floors subject to seepage or prevalent moisture, the raceways may in some cases be routed overhead to avoid traps or water pockets.

Outlet and equipment location: The wiring plans must show outlet locations for exit and emergency lights to comply with the National Electrical Code, state and local fire or safety regulations. The locations of equipment for non-compulsory systems such as annunciators, loudspeakers, etc., should be chosen for ready access, step-saving, audibility or visibility. Transformers, charging devices, master instruments, relay panels, and junction or distributing cabinets should be located to permit easy access for maintenance.

Circuit routings should be shown on wiring plans to indicate outlet inter-connection. If future extensions to the system are contemplated, the careful routing and termination of initial circuits will greatly simplify such work later on. Unless circuit or cable runs are clearly determined on the wiring plans, frequent tap-offs or multicable splices may be attempted which would tend to complicate maintenance of the system.

To simplify the routing and identification of auxiliary system conductors or cables, junction or terminal cabinets should be located at accessible points.

All branch circuits that supply power to auxiliary systems, such as for signalling transformers, battery chargers, converters, or for synchronous clock systems should be clearly identified within the panelboard to prevent them becoming disconnected by mistake. This is most likely to occur at panelboards from which groups of lights are turned on and off by various persons. The levers of such special circuit switches may be omitted, locked or of the key-insert type, or these switches placed in a sectional locked panelboard door.

Lighting panelboards: The simplest form of panelboard is that providing one fuse or circuit breaker for each ungrounded circuit conductor, or, for the ordinary two-wire circuit, one per circuit. For circuits under 30 amp. operating at not over 125 volts, plug fuses are generally preferred to cartridge fuses as being easier to replace, less expensive and occupying less space.

Branch circuit switch control at the panelboard is commonly provided in retail stores and in large spaces where it is convenient to have a single point of control, except where a more elaborate control system is called for, as in a theatre or other assembly hall. In an apartment building, hospital, or school building, local control by means of wall switches is necessary and circuit switches on panelboards are usually single-pole and of 30 amp. rating.

Branch circuit breakers provide both overcurrent protection and individual circuit control.

If any heavy-duty circuits are to be used and if the load per circuit would exceed 30 amp. after replacing the original lamps with lamps one size larger, the panelboards must be specially equipped for the protection of these high wattage circuits.

Panelboards can be obtained with main fuses or a main circuit breaker. Such equipment is usually the most practical means of providing overcurrent protection for a panelboard where such protection is required. A main switch or circuit breaker may be useful if all circuits are to be controlled together; for example, a panelboard supplying show window lighting only.

Spare circuit equipment should be provided on every panelboard amounting to at least one spare circuit for each five circuits utilized in the original layout. Where the cabinet is built into the wall, provisions should be made for bringing this number of circuits out of the cabinet without channelling the finished wall. Such provision may consist of empty raceways run up from the cabinet to covered outlet boxes located in the ceiling, or run down to boxes in the ceiling of the story below, or both; or by leaving space for two additional wires in each run from the panelboard to the first outlet.

Each of the following considerations shall be given due weight in determining the required number of panelboards and their location:

Good practice limits the number of branch circuits distributed from one location or panel to a maximum of 42.

No branch circuit run from the cabinet to the first outlet should exceed 100 ft.

Panelboards should always be accessible for the replacement of fuses or the resetting of circuit breakers. If circuit switches or circuit breakers are to be used for the control of lighting equipment, convenience of access for this purpose should also be considered.

Panelboard locations should be so chosen that the feeders will be as short as possible and may be brought to the panels with a minimum of expense for bends and offsets. It is difficult and often impossible to install large conduits concealed in the floor construction.

In a small building consisting of one story and a basement, a single panelboard located on the main floor may be sufficient. For larger buildings, one panelboard per floor may be considered the minimum.

Lighting feeder capacity: The minimum sizes of feeders to provide for carrying capacity are to be based upon a load of 1,000 watts for each 15 amp. branch circuit installed, plus the total initial wattage of all heavy-duty lamp circuits, plus 500 watts for each spare circuit provided on the panelboard.

A demand factor as permitted by the National Electrical Code may be applied to the total wattage. This demand factor will be 100 percent for all retail stores and for small buildings of any occupancy.

Having determined the maximum demand in watts (total computed wattage x demand factor) for each feeder, the current per feeder is calculated as follows:

Two-wire, 120-volt system	$\frac{\text{Watts}}{120} = \text{amp.}$
Three-wire, 120-240 volt system	$\frac{\text{Watts}}{240} = \text{amp.}$
Four-wire, three phase, 120-208-volt system	$\frac{\text{Watts}}{360} = \text{amp.}$

Voltage drop. A voltage drop should not exceed 1.5 percent in the feeder system from the service entrance to

any panelboard. Using the maximum demand amperes computed as explained above, the size of conductors required for 1.5 percent drop should be calculated and this size should be used if it is larger than the size required for carrying capacity.

Provide for future increase in feeder capacity. All branch circuit calculations are based upon a possible future increase of 50 percent in the load on 15 amp. circuits and the substitution of lamps one size larger than the original lamps on heavy-duty lamp circuits. In order to make it possible to use this excess circuit capacity, provision must be made for a corresponding increase in the feeder capacity. This may be done (1) by installing oversize feeders originally, (2) by installing oversize conduits so that the original feeders may be replaced with feeders of larger size, or (3) by arranging the installation so that additional feeders can be installed at some future time at a minimum of expense.

(1) Where the conductor size required for the initial load is No. 8 or smaller, conductors large enough to provide for the future increase in load should be provided in the original installation. The additional cost of the larger conductors in such a case will be so small as to be unimportant.

(2) Up to a conductor size of about No. 1, conduits should be installed of sufficient size to contain feeder conductors of the size required for the future increase in loading. This will usually require, if the three-wire system is used, $1\frac{1}{2}$-in. conduit for No. 6 or No. 4 conductors and 2-in. conduit for No. 2 or No. 1. Then when the need arises the original conductors can be withdrawn and replaced with conductors of larger size.

(3) Where the conductors are replaced as in (2) the original conductors have only a scrap value. To avoid this waste in the case of large cables, spare conduits may be installed so that the increased capacity may be provided by installing additional feeder cables. This method, however, requires that the original layout be planned with special care. It is not good practice to multiple two conductors of unequal size, hence the installation should be planned to utilize the additional feeder capacity by sectionalizing each panelboard or by changing the connections so as to supply certain panelboards by the new feeders.

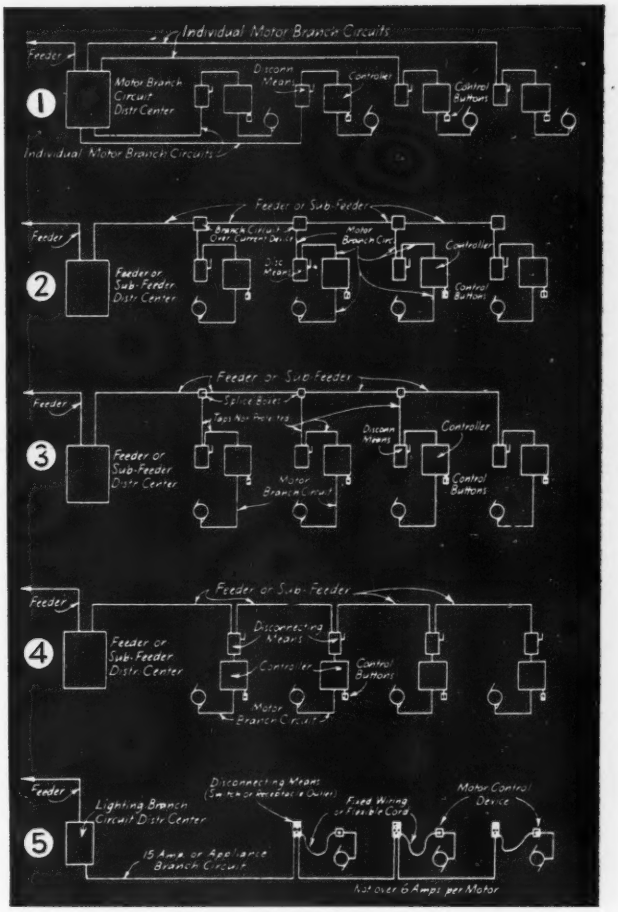
Power feeders: Because of the varying factors in power feeder design as to routing, grouping of motors and voltage loss, five common methods of design or types of layouts must be considered.

(1) A separate circuit may be run to each motor from a branch circuit distribution center.

(2) A feeder or sub-feeder may be carried around the building with branch circuits tapped to the feeder at various points, no branch circuit distribution center being used. Busbar distribution systems with taps to individual motors come within this group.

(3) A feeder or sub-feeder may be carried around the building with sub-feeder taps, having no individual overcurrent protection, carried direct to the disconnecting means or controller for each motor. In this case, the branch circuit overcurrent device is usually omitted and the motor branch circuit originates at the controller.

(4) A feeder or sub-feeder may be carried direct to the disconnecting means or controller for each one of the



group of motors. Otherwise the layout is the same as in (3).

(5) A group of small motors, each having a full-load current rating not exceeding 6 amp., may be supplied by a 15 amp. branch circuit or an appliance circuit. For conditions under which each of the foregoing types of layouts can be used and installation requirements applying in each case, see the National Electrical Code.

Application of various types of layouts: Type (1) can be used under any condition and is the type most commonly used. It is usually the preferable type for supplying the miscellaneous power loads in a commercial or public building and is also common in industrial plants.

The use of Types (2), which includes busbar distribution systems, (3) and (4) is chiefly in industrial plants where a large number of motors is used to drive individual machines. Type (2) requires for each motor a branch circuit overcurrent device. In Type (3), no branch circuit overcurrent device is required, but the conductors from the sub-feeder to the controller must be larger than in Type (2). Type (4) may show an economy in cost over either Type (2) or Type (3) if the subfeeder can be economically brought direct to each controller.

Type (5) is merely a means of providing for small motors used with household and commercial appliances, by permitting them to be connected to lighting or appliance branch circuits. This is not to be considered as a type of layout having application in a factory.

For power applications in industrial plants, the first four types of layouts may be considered as on a par as regards serviceability. The choice between these types

should be made on the basis of economy in cost of installation and flexibility, i.e., adaptability to changes in sizes and locations of motors.

Voltage drop and carrying capacity of conductors: All conductors must have sufficient carrying capacity, according to the National Electrical Code requirements, and should also be of such size that the total voltage drop to any motor will not exceed 5 percent.

On any system operating at 208 volts or higher, it is recommended that the voltage drop in motor branch circuits should not exceed 1 percent, in which case a drop of 4 percent in the feeders is allowable. It will be found that with the minimum conductor sizes permitted by the National Code, the feeder voltage drop will exceed the 4 percent limit only where a feeder is unusually long. In any case where the drop will exceed 3 percent, the annual cost of the kilowatt-hours consumed in copper losses should be computed and consideration should be given to the installation of larger conductors in order to reduce this loss.

In an industrial plant it is almost always desirable to install service and feeder conductors of larger sizes than are required for the initial load. Besides providing for load increases, the excess size will also have the advantage of reducing the copper loss.

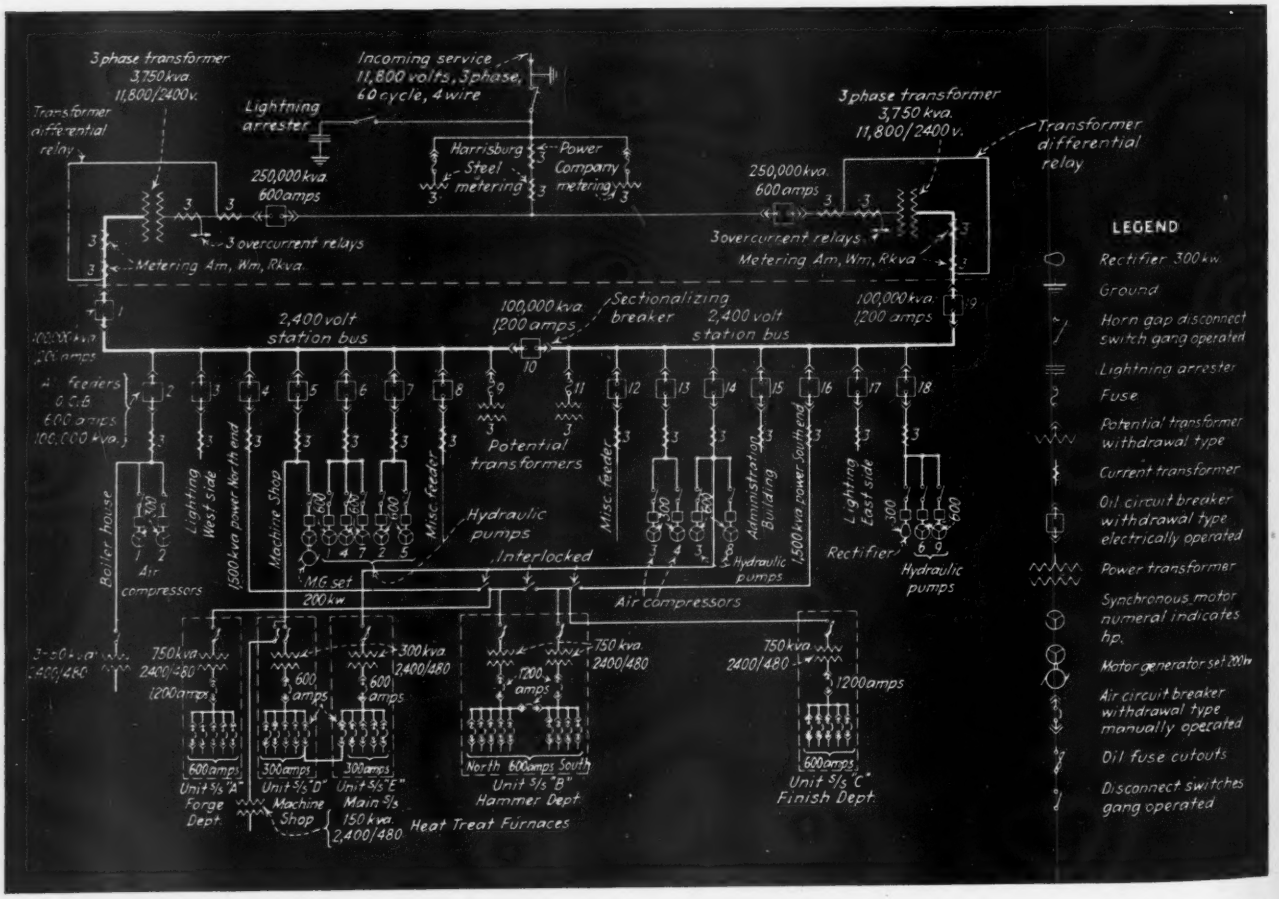
In a small wiring installation only a single feeder may be required, extending from the service equipment to one or more branch circuit panelboards or motors. If the layout calls for two or more feeders, a feeder distribution center must be installed to provide for the protection of each feeder.

The modern types of feeder distribution centers include dead-front panelboards, dead-front switchboards, and assemblies of enclosed, externally-operable units, composed of either switches and fuses, or circuit breakers. The equipment for a small installation is termed a panelboard and is usually mounted in a cabinet on or in a wall, while for a large installation a switchboard standing on the floor and accessible from the front or rear is more suitable.

Assemblies of externally-operable switches or circuit breakers are adaptable to all installations, small or large.

Suitable provision should be made for the protection of feeders of increased size. All that is necessary is to provide space for the future installation of larger switches or circuit breakers, and means of making connections to the larger equipment without disturbing such of the original equipment as may be retained. If a panelboard is used, it is suggested that it be of the sectional type, with space in the cabinet to contain the larger equipment and with buses large enough to carry 150 percent of the initial load. If a switchboard or assembly of unit devices is used, it is suggested that the buses be as recommended for panelboards and that the switchboard or assembly be specially designed to accommodate the larger equipment.

Service: The first step in determining the size of the service conductors and the capacity of the service equipment (switch and fuses, or circuit breaker) is to compute the total initial load by totalling the feeder loads. These should be the loads computed for the various feeders before any permissible demand factors less than 100 per-



System diagrams show details of networks and equipment.

cent have been applied. Any power load should be segregated. By "power load" is meant any load consisting of motors or electrically heated equipment that is not to be supplied by "15 ampere" or "appliance" branch circuits as defined in the National Electrical Code.

The demand factor permitted by the National Electrical Code should be applied to the total load other than power load. In most cases, no demand factor less than 100 percent should be applied to the power load. For a single service supplying a combined load of lighting and power, the total capacity will be the sum of the lighting load after applying the demand factor, and the power load.

Provision for increased capacity: Provision having been made in the other portions of the wiring system for a future increase in the lighting load, provision should also be made for a similar increase in the service capacity.

The original installation should include service entrance conductors and service equipment having the required excess capacity in every case where the rating of the equipment, as thus determined, will not exceed 400 amp.

Where the calculated future load exceeds 400 amp., an individual study should be made of each case. Due weight should be given to each of the following considerations:

(a) In any building having an expectant life of ten years or more, it is highly probable that some additional service capacity will be needed.

(b) In most cases, additional capacity can be provided only by tearing out and completely replacing the original service conductors and service equipment and the larger the service, the greater the expense involved.

(c) Considerable additional expense is involved in providing 50 percent excess capacity in the case of a heavy service and this is a non-productive investment until some part of the excess capacity is utilized.

Transformer stations: Where the calculated demand load is sufficiently large or where the structural design makes it more economical to provide one or more transformer stations in a building, detailed drawings and specifications must be prepared. These details should be prepared after consulting with the local inspection authorities, and with the local power company that is to serve such transformer equipment.

Drawings should be prepared in large scale to supplement the locations shown for such stations on the general wiring plans. A schedule of transformer station materials may be inserted upon the detail drawings, which may be used also as a specification.

Standard unit substations are frequently used in industrial installations and simplify layout and planning.

2.1 Service Entrances

Service entrances include the point of connection to utility service apparatus, conductors and raceways connecting to the first point of distribution within the building and the main disconnecting means.

Service entrances consist of two general types:

1. Primary services; electric service purchased, metered and connected at utility distribution voltage and transformed to utilization voltage by the user.

2. Secondary service; electric services purchased, metered and connected at utilization voltage.

Primary services are usually economical only for large properties involving heavy power consumption. Secondary service is customary for ordinary commercial and industrial buildings. Utility engineers should be consulted.

Service installations follow two general types:

1. Overhead services; open conductors run overhead from the utility pole to the point of connection.

2. Underground services; service conductors carried underground from the utility pole or vault to the point of connection on the customer's premises.

Considerations are usually economic and determined by the type of job, utility rules and safety requirements. Primary services and large secondary services in urban areas are usually underground. Residential and small commercial services are usually overhead.

Specification should indicate the type of service giving the voltage, frequency and phase characteristics.

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2.11 Service shall be .....wire, ...phase, ...cycle, ...volts, furnished and connected by the..... Company to the point of connection indicated on the plans.

Service shall be 3 wire 3 phase 60 cycle 2500 volts furnished and connected by the Mid-state Power Company to the point of connection indicated on the plans.

The type of service should be indicated on the plans giving height and other pertinent details. For overhead services state in the specification the number and size of conductors, the type and size of terminal bracket. For underground services state the type and size of conduits, depth of installation, concreting or reinforcing required, the type and size of terminal fitting or seal.

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2.12 Primary services: Primary service requirements vary widely with the practices of individual utility systems. Consult with the utility engineers whenever developing specifications for a particular project.

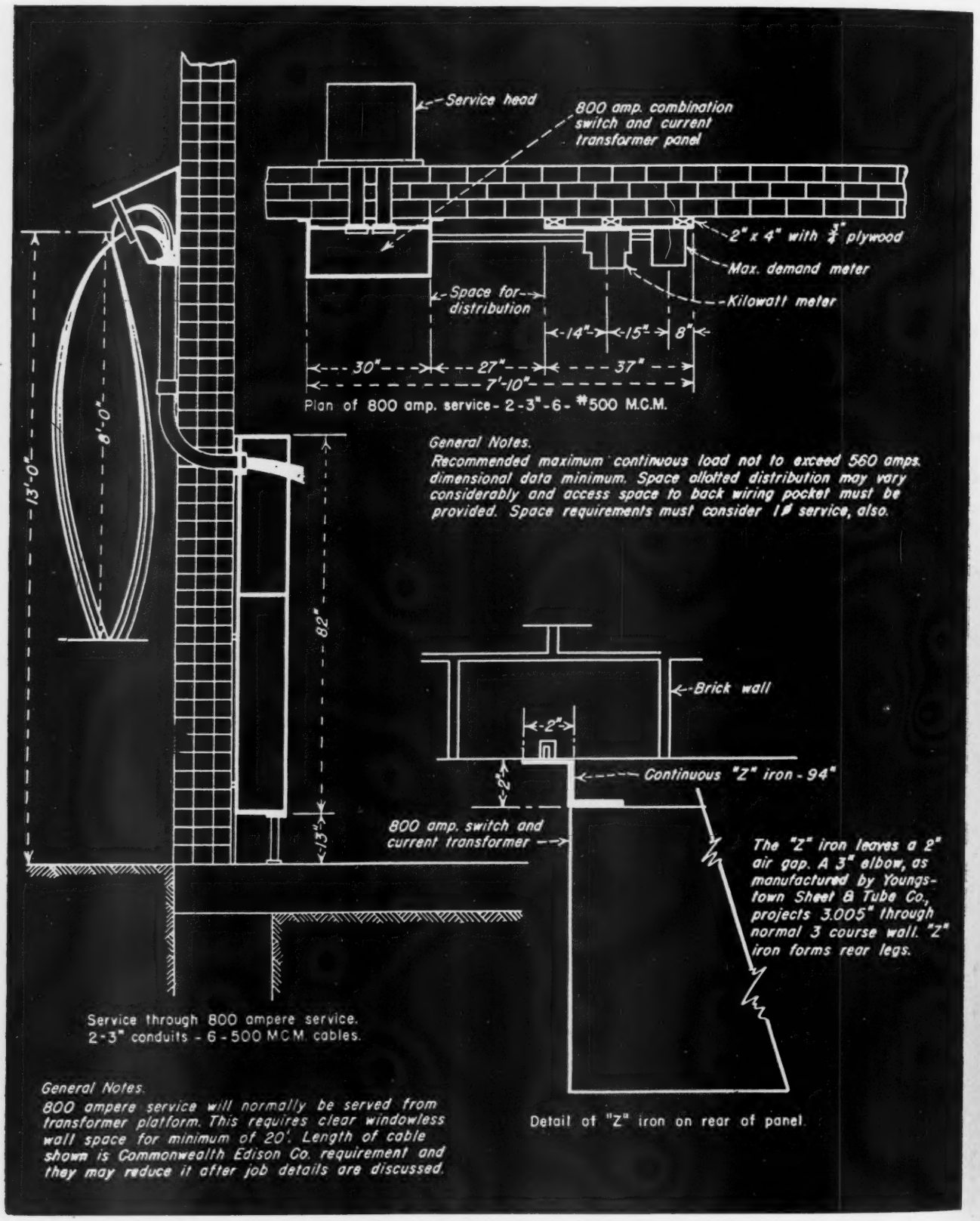
The specification should state by whom the service furnished and installed.

For primary services and feeders to substations and transformers, the following items may be covered by the specifications:

(1) Number, type, size, and voltage of cables,
(2) Number, type, and size of ducts and conduits,
(3) Type of elbows and pipe bends (wide sweep),
(4) Racking of cables (in vaults and manholes),
(5) Fireproofing of exposed cables,
(6) Grounding cable sheaths,
(7) Tagging cables,
(8) Testing cables,
(9) Concreting ducts,
  (a) Amount of concrete around ducts,
  (b) Concrete mix,
  (c) Conduit spacers,
(10) Rodding ducts,

(11) Excavating and back filling,
- (a) Depth of duct runs,
- (b) Soil conditions,
- (c) Backfilling and tamping,

In some cases it may be necessary to specify such special items as:
- (1) Re-enforcing concrete over unstable soil or under tracks and driveways,
- (2) Shoring sides of trench,
- (3) Pumping water.



Typical details of a large secondary service entrance.

Primary Service: Furnish and install (number and size) conduits between the utility vault and the customer's vault as shown on the plans. Conduits shall be:

a. Rigid galvanized conduit.

b. Impregnated fiber conduit properly seasoned and free of defects. Conduits shall be furnished in manufacturers standard lengths and shall be of uniform wall thickness. Joints shall be made waterproofed with an approved compound.

c. Asbestos cement conduit of the best quality installed and waterproofed at the joints according to the manufacturers recommended methods.

Conduits shall be installed not less than .... inches below the surface and shall grade in the direction shown on the plans.

Conduits shall be enclosed in a concrete envelope not less than .... inches in thickness.

Example.

Furnish and install three 4-inch conduits between the utility vault and the customer's vault as shown on the plans. The conduit shall be impregnated fiber of the best quality, properly seasoned and free of defects, furnished in the manufacturers standard length and shall be of uniform wall thickness. Ducts shall have sleeve joints waterproofed with an approved compound. They shall be installed not less than 24 inches below the surface and graded away from the interior vault. They shall be enclosed in a concrete envelope not less than 3 inches in thickness.

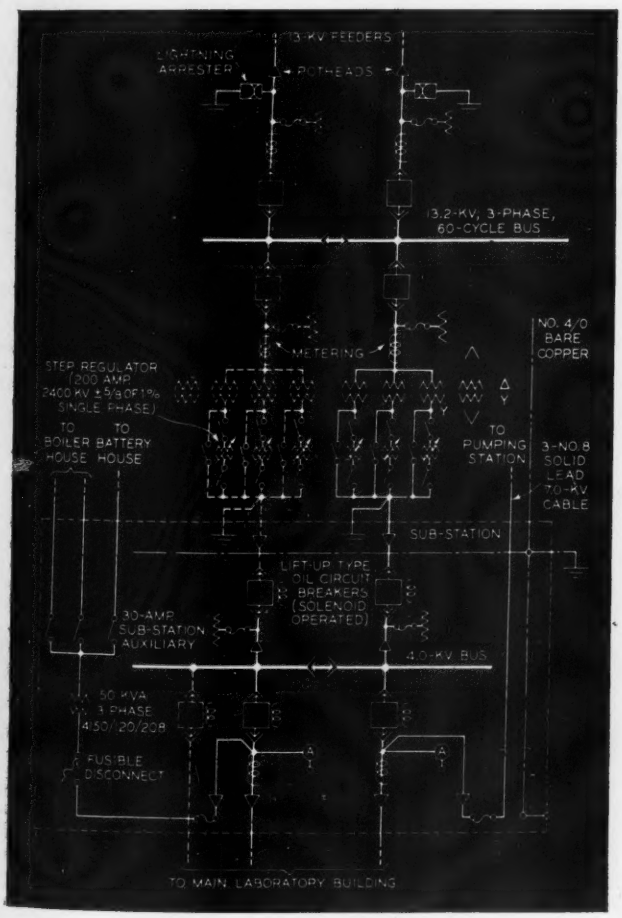


Diagram of high voltage service.

2.13 High voltage cable: All high voltage cable shall be impregnated, varnished cambric, or paper insulated, lead covered insulated for voltages and sizes as specified or shown on drawings.

Cable shall be of the very best obtainable quality, manufactured in accordance with the best acceptable practice. All such wire and cable shall be in accordance with, and conform to the latest requirements and specifications of the Insulated Power Cable Engineers Association.

All high tension cables exposed in vaults, manholes, pull boxes or switch rooms or splice chambers and all locations not protected with conduit shall be fireproofed with two wrappings of 3/16 inch thick pure asbestos felted tape backed with coarse jute cloth and covered with at least a 3/16 inch thick smear coating of asbestos cement. The felted tape shall be immersed in a solution of asbestos cement until it has become thoroughly impregnated and then wound spirally on cable with butted joints and without lap except at bends. The second layer shall be wound spirally in the opposite direction. The asbestos cement shall consist of a chemically neutral powder guaranteed to have no deleterious effect on the lead covering or braid of the cable and to withstand immersion either constant or intermittent without effect on the fireproofing or the mechanical qualities.

Splices—All high voltage splices shall be made with an approved splice for the cable furnished, and shall be of such quality as recommended by the manufacturer of the cable furnished. Splices shall be made by workmen familiar with the art of splicing, and all such splices shall be completed once started.

Potheads: High voltage cables shall be terminated with potheads having the rated voltage and conductor capacity to accommodate the cables used. Mounting shall be as required for the conduit system installed. Potheads shall be filled with compound suitable for high voltage service. Care should be observed to avoid heating the compound to a higher temperature than that recommended by the manufacturer.

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2.14 Secondary service: The size, voltage, frequency and source of supply should be given in the specification or on the drawings. Metering sequence and connections should be described or diagrammed and any special features explained.

Service entrance conductors shall be run from point of connection by the utility to the service switch at the location shown on the plans.

a. Service shall consist of four No. 4/0 conductors in rigid conduit run underground as shown on the plans.

b. Service shall be four No. 4/0 conductors in conduit. Conduit shall be run through the wall to a standard service ell fitting and up on the outside to a service head. The insulating cover shall be of a type which separates the conductors. Three feet of conductor shall be left extending from the service head for connections to the utility service drop. An approved bracket shall be furnished and installed adjacent to the service head for terminating the service drop. Installation shall be in accordance with the rules of the utility company.

2.15 Service entrance, residential: The size of service entrance conductors and the rating of service equipment shall not be less than that specified for the floor areas in the table (right). All service shall be 3 wire, 115/230 volt.

The table (right) provides service sizes adequate for normal lighting and portable appliance loads and for a range and a water heater. In addition it provides for a possible increase by the amounts shown in the last column. If these wattages are to be exceeded, service size should be increased accordingly. If, however, the initial wattages are less than those shown, the service size should be at least those given above so that future growth in load may be accommodated.

Floor Area (Sq. Ft.)	Capacity Service Conductor (Amperes)	Rating of Service Equipment			The service capacities provided for in table are sufficient to supply lighting, portable appliances, a range, a water heater, and additional appliances, supplied by individual equipment circuits, having a total rating in watts as follows:
		Circuit Breakers	Switch and Fuse		
			Switch	Fuse	
Up to 1,000	60	70	60	60	3,500
To 1,500	65	70	100	70	4,200
To 3,000	85	90	100	90	8,800
To 4,000	100	100	100	100	9,500

2.2 Grounding

All metallic conduits, supports, cabinets and equipment shall be grounded in accordance with the latest issue of the National Electrical Code.

The carrying capacity of a grounding conductor for direct current systems shall not be less than the capacity of the largest conductor supplied by the system, except where the grounded circuit conductor is a neutral derived from a balancer, the size of the grounding conductor shall not be less than the neutral, in no case smaller than No. 8.

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2.21 Grounding conductors: The size of the grounding conductor, for an alternating current system, a common grounding conductor, or a grounding conductor for service equipment shall be not less than given in the following table.

Size of Largest Service Conductor or Equivalent for Paralleled Conductors	For Wiring System and Service Equipment	For Service Equipment Only	For Service Equipment Only
	Copper Wire No.	Conduit or Pipe (Inch)	Electrical Metallic Tubing (Inch)
2 or smaller	8	½	½
1 or 0	6	½	1
00 to 000	4	¾	1¼
Over 000 to 350,000 C. M.	2	¾	1¼
Over 350,000 to 600,000 C. M.	0	1	2
Over 600,000 to 1,100,000 C. M.	00	1	2
Over 1,100,000 C. M.	000	1	2

Conduit, pipe or electrical metallic tubing cannot be used alone as the grounding conductor for a wiring system. Wire sizes apply both to bare and insulated conductors.

Interior raceway and equipment: The size of the grounding conductor for conduit, cable sheath or armor, and other metal raceways or enclosures for conductors, and for equipment, shall be not less than given in the following table,

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc. Not Exceeding (Amperes)	Size of Grounding Conductor		
	Copper Wire No.	Conduit or Pipe (Inch)	Electrical Metallic Tubing (Inch)
15	16*	½	½
30	14	½	½
40	12	½	½
60	10	½	½
100	8	½	½
200	6	½	1
400	4	¾	1¼
600	2	¾	1¼
800	0	1	2
1000	00	1	2
1200	000	1	2

* Permissible only when part of an approved cable assembly.

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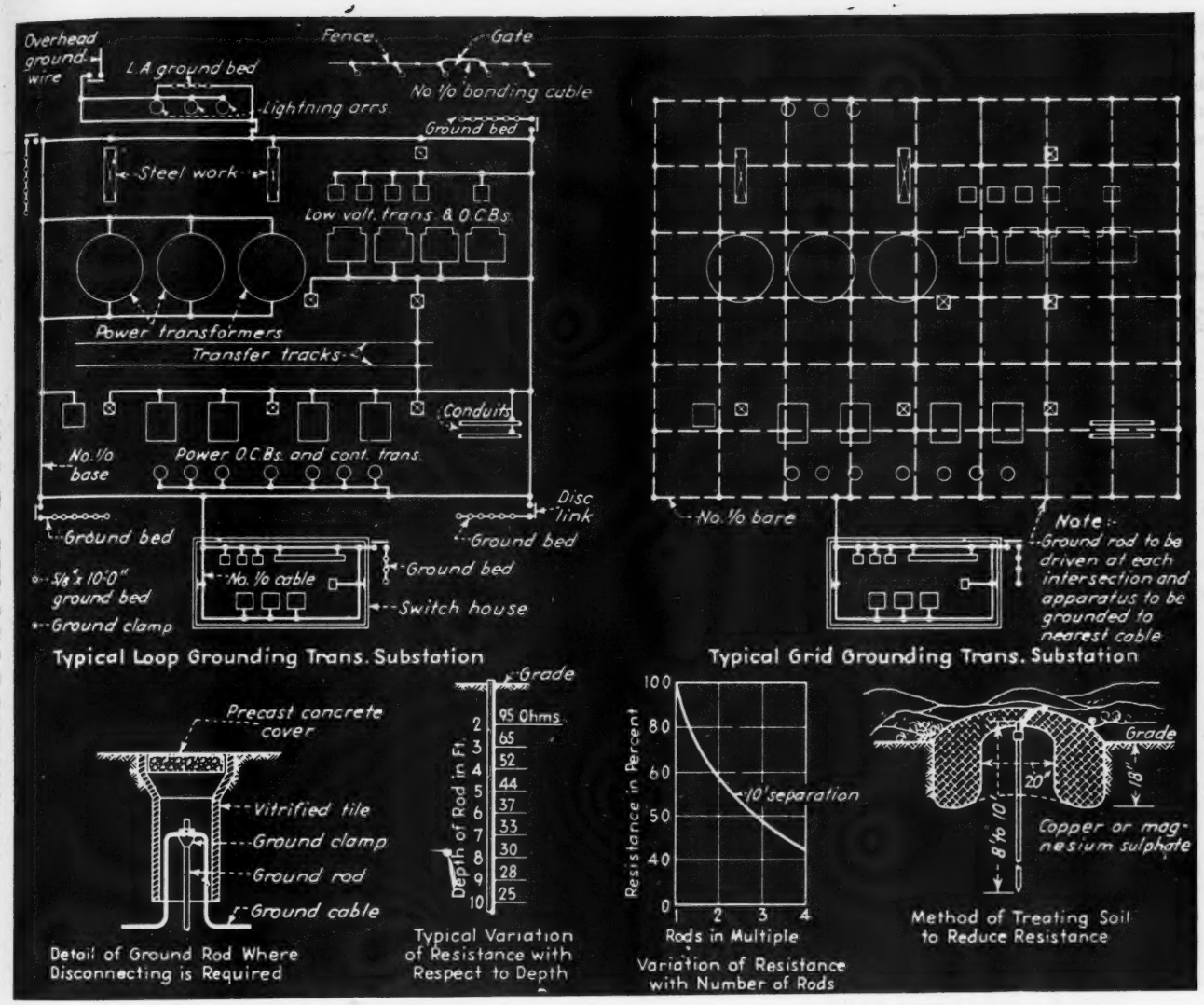
2.22 Grounding large buildings: Transformer tanks, three-position disconnecting switches, cubicle framework; ground bus in cubicles; cable supports and non-current carrying metallic parts of all equipment and conduits shall be securely grounded by connection to a common ground bus insofar as practicable and ground bus connected to nearest water pipe. Ground connections shall not be less than 1/0 copper, connected throughout with clamp fittings. No soldered connections shall be used in leads.

The neutral point of all secondary windings of all network or lighting transformers shall be connected to a separate grounding system. The neutral leg of the main bus at the various main switchboards shall also be connected to this ground bus at the switchboard. The ground bus and connections shall be not less than 500 MCM bare copper wire, and same shall be connected to the nearest cold water pipe. Connections shall be made to this pipe with a copper or brass pipe clamp. These connections shall be made on the street side of the water meters, or jumpers shall be installed by-passing all meters. A complete system shall be installed for each vault, and same shall be in accordance with the latest edition of the National Electrical Code. All ground conductors, and taps from equipment to bus shall be made with copper, with as few connections as possible.

Bus shall be continuous without joints or splices through-



Complex equipment grounding details showing connections, wire sizes and grounds.

out its length. All connections from bus to taps, and bus to bus shall be made with an approved type of solderless connector, and all grounding conductors shall be protected from mechanical injury, and shall be rigidly supported. If ground conductors are run through conduit they shall be securely bonded to such conduit at the entrance and exit. All connections to equipment or conduit shall be made with an approved type of solderless connector, and same shall be bolted or clamped to equipment or conduit. All contact surfaces shall be thoroughly cleaned and bright before connection is made so as to insure a good metal to metal contact.

No ground wires smaller than No. 8 shall be used, and a wires larger than No. 8 shall be bare copper cable.

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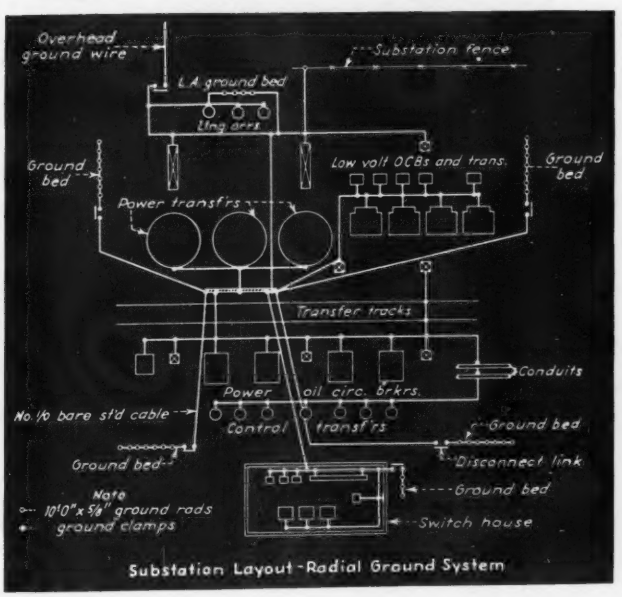
2.23 Grounding small buildings: Ground connection shall be made by connecting one end of a wire to the neutral service conductor at main switch and the other end to the cold water pipe where shown on plans. Ground wire shall be same kind and quality as other conductors in the building, shall be placed in steel conduit run as specified for branch circuits, and shall be of the size required by the National Electrical Code. Where the ground connection is made to the water pipe on house side of water meter, a jumper or shunt shall be installed around the water meter. The current-carrying capacity and mechanical protection shall be not less than required for



the grounding conductor. Where a grounding conductor runs through metallic conduit, it shall be securely bonded to the conduit at the entrance and exit and the conduit shall be fitted with a bolted clamp to secure same to water pipe.

Grounding cable: Lead sheaths of underground cables shall be bonded together and grounded at each manhole. Primary underground feeder systems shall include a 500,000 CM bare conductor installed in the duct system and connected to a driven ground rod in each manhole and to underground water piping as shown on the drawings.

Grounding metal clad assemblies: Provide a ground bus with a cross-section equal to at least 25 percent of the capacity of the largest circuit. Each housing shall be bolted securely to the bus.

3.1 Transformers

3.11 Transformer stations: Where the demand load will be sufficiently high to justify the installation of one or more transformer stations on the premises, the following should be observed:

Transformers may be installed to operate on primary feeder distribution systems of various voltages.

Installation design details must conform to the National Electrical Code and local or state regulations. They must also meet the approval of the power supply company.

Types of stations which may be considered are:

a. Single stations supplied by primary service conductors.

b. Master stations supplied by primary service conductors, and which in turn supply two or more transformer sub-stations located in various parts of the customer premises.

c. One or more transformer stations located in various parts of the customer premises, such as different floor levels, all served by a primary distribution network.

d. Load center assemblies designed for installation within buildings without vault protection.

Transformer stations may be located as follows:

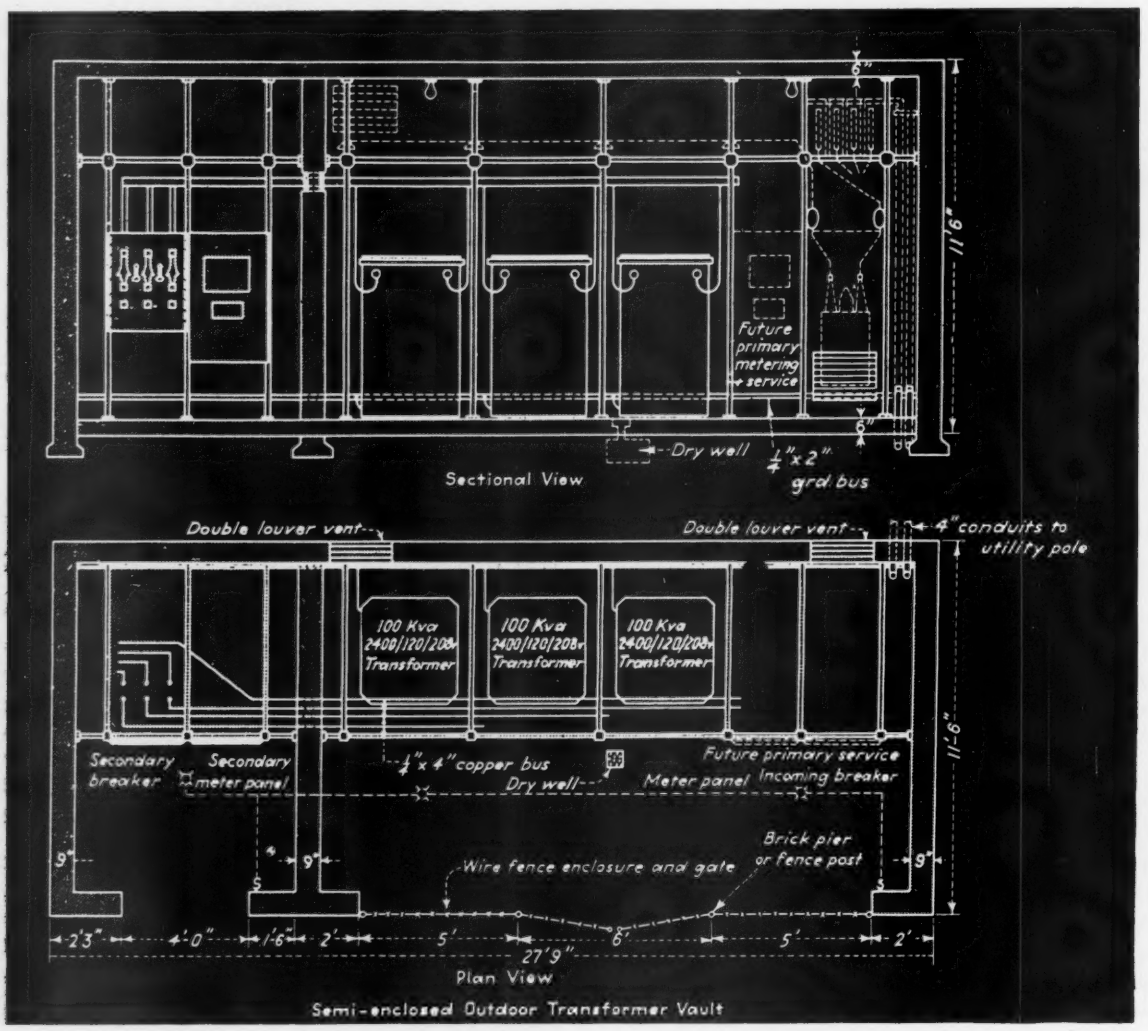
a. In one or more approved rooms or vaults in a building.

b. Upon the building roof.

c. Attached to the outside of buildings.

d. Placed on the ground or in underground vaults in suitably guarded enclosures.

e. Installed above the ground upon poles or other approved supporting members.



Transformer vault detail giving layout, dimensions and principal fixtures of the installation.

f. In metal clad unit substations.

The principal electrical requirements are:

a. Interrupting capacity of primary switchgear,
b. Lightning arresters,
c. Disconnecting devices,
d. Grounding networks,
e. Secondary control devices,
f. Service and inside wiring, clearances, bus structures,
g. Control and metering transformers and connections,
h. Arrangement of transformers for ease of emergency isolation, and of replacement in case of burn-out.

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3.12 Load center assemblies: Furnish and install as shown on the plans. Indoor load center unit substations: Each substation will have the following self-cooled rating in accordance with the Standards of the American Institute of Electrical Engineers:

Capacity (55 C).....(give size) kva.
Frequency .....60 cycles
Phases .....Three
One incoming, 3 wire, ...volt circuit.
..... outgoing, ... wire, ...
volt feeder circuits. (Give primary and secondary voltages.)

Each unit substation will consist of the following co-ordinated parts:

One incoming line section with one interrupter switch, two-position, mounted directly on the transformer. The switch will be suitable for making and breaking the magnetizing current of the transformer. Suitable key interlocking with the low voltage air circuit breakers will be provided so that the switch cannot be opened or closed with load on the transformer.

One transforming section with three-phase, self-cooled, Askeral-filled transformer in accordance wtih the applicable sections of Standards of the ASA.

Rating: 750 kva. (55C)—60 cycle. High voltage, 13,200 delta—Low voltage, 480 delta.

Four approximately 2½ percent rated kva. capacity taps in the high voltage winding, two above and two below rated primary voltage, brought to externally operated manual tap changers which are to be operated only when the transformer is de-energized.

Standard accessories shall be furnished, including:
Drain valve and sampling device,
Filling connection,
Filter press connection,
Jack bosses,
Thermometer,
Liquid level gage,
Sampling device,
Relief diaphragm,
Lifting lugs,
Cover lifting eyes,
Pressure test connection and air vent,
Ground lug.

The transformer base construction will be of fabricated type and suitable for using rollers or skidding in any direction.

The low voltage bushings and transition will be properly coordinated for field connection to the low voltage switchgear section.

One low-voltage feeder switching section with one indoor-type, metal enclosure with hinged front doors, removable rear plates, bare copper buses and provision for bolting to the transformer section in the field to form an integral unit.

One main transformer secondary air circuit breaker, drawout type, manually operated, with adjustable time overcurrent protection, instantaneous short circuit trip. (specify rating, voltage and interrupting capacity).

Each space will include hinged front door, housing, bus, and stationary disconnecting devices. (Specify rating, voltage, and interrupting capacity).

The above drawout low voltage air circuit breakers will all be equipped with safety interlocks which prevent withdrawing or inserting the breaker when it is in the closed position, manual trip button, external visual indication of breaker position, arc quenchers, and insulated closing handle for manually operated breakers.

One incoming-line section with indoor type metal enclosure with metal-enclosed transition compartment for connecting to the transforming section in the field to form an integral unit. The following equipment will be mounted in this section:

Circuit breaker control switch with red and green indicating lamps,
Control power switch,
Askeral control power transformer with current-limiting fuses,
Power circuit breaker, (Specify rating voltage and interrupting capacity),
Ammeter and transfer switch,
Current transformers of suitable rating for the overcurrent relays,
Inverse time overcurrent relays with adjustable instantaneous trip.

4.1 Switches & Panels

4.11 Service entrance switches: Service entrance switches shall be of the metering type enclosed in steel cabinets. Fuse types shall be so interlocked with the eternal switch handle that the door cannot be opened except when the switch is in the "off" position and that the switch cannot be placed in the "on" position except when the door giving access to fuses is closed. Further, when this door is open no uninsulated live metal terminal or other live metal parts whatsoever shall be accessible. Switch shall be provided with meter test facilities, brackets and meter trims.

Service entrance switches shall comply with the requirements of the Underwriters Laboratories of the National Board of Fire Underwriters for enclosed switches or for service equipment and each switch shall bear manufacturer's name and the Underwriter's Laboratories label.

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4.12 Panelboards equipped with fuses: Panelboards shall be of standard types and the product of established manufacturers. The sizes of switches and fuses shall be as

shown. Each circuit shall be provided with fuses in all poles except neutral.

Pull out type switches shall be dead front when closed and fuses shall be dead in the open position. Branch circuit panels shall be dead front equipped with switches and fuses. Switches shall be heavy duty tumbler type.

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4.13 Panelboards with circuit breakers: Branch circuit panelboards shall be the dead front safety type equipped with circuit breakers. Busbars shall have lug connections for attaching feeders and arranged for wire mains and two wire branches, unless otherwise noted on drawings. The grounded side of each branch circuit shall be fed direct from the neutral busbar located at top of panel. The circuit breaker shall control the ungrounded side.

Distribution panelboards shall be of the dead front safety type equipped with circuit breakers. Busbars shall have lug connections for attaching feeders. The sizes of circuit breakers shall be as noted on drawings and unless otherwise noted shall be double pole for 3 wire single phase or 3 pole, for 4 wire, 3 phase 250 volt circuit breakers, with the neutral connected to common busbar at top of panel for grounded neutral systems.

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4.14 Switchboard equipped with automatic circuit breakers: Switchboard shall be the dead front safety type consisting of panels and circuit breakers of the number and sizes shown on the drawings. The construction shall consist of a structural or formed steel frame carefully built into a rigid structure which shall maintain its alignment and not be damaged in shipment or erection or by stresses resulting from short circuits. The frame shall be completely enclosed on front and sides with sheet steel plates. Adequate ventilation shall be provided. A pull box of the same type of construction shall be provided at the top of each switchboard which shall match the switchboard in dimension and finish. Bottom of pull box shall be slate or asbestos board and cables to circuit breaker studs dropped vertically through individual openings in bottom to their respective studs. Switchboard shall be sectionalized to permit access to the circuit breakers.

Buses on switchboard shall be of hard drawn copper of 98 percent conductivity. Connections shall be bolted and laminations interleaved to secure maximum contact areas. All laminations shall have a 1/4 inch space between them. All buses and circuit breaker stub connections shall be of such size as to limit the temperature rise to 30 degrees Centigrade when carrying full-load current at room temperature, but not to exceed a current density of 1000 amperes per square inch. Buses shall be suitably arranged for single phase 3 wire, 3 phase 3 wire, or 3 phase 4 wire distribution as shown on drawings.

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4.15 Cabinets: All cabinets shall be made of sheet steel. Cabinets for panelboards shall provide proper space for all wires and connections.

Cabinets for telephone terminal strips and connection points shall be of sizes and depths noted on plans.

Cabinets shall be of standard make and shall bear the manufacturer's name plate or stamp and the Underwriter's Laboratories inspection label.

The thickness of steel for cabinets and fronts shall be not less than the following, the gauge numbers referring to United States Standard Sheet Metal Gauge.

Maximum Dimension	Maximum Area	Box Gauge	Front Gauge
Inches	Square Inches		
25	600	16	14
40	1,000	14	12
60	1,500	12	12
Over 60	Over 1,500	10	10

Fronts for flush cabinets shall consist of sheet steel frame and a hinged door with catch and lock. Frame shall be about 3/4 inch larger than cabinet on all sides and shall be set with its back flush with the finished wall.

Telephone and signal cabinets for surface mounting shall be equipped with a door hinged directly to cabinet. Door shall be made of one piece of sheet steel and shall have a 3/4 inch flange around all edges shaped to cover edge of box and equipped with catch and lock.

Lighting and power cabinets for surface mounting shall be equipped with a sheet steel frame and hinged door with catch and lock. Frame shall be the same size as cabinet and shall completely cover wiring gutter.

Each cabinet shall be furnished with a catch and flat key lock. All locks shall be fitted to the same key. Furnish keys for each job.

All cabinets shall have proper means for securing, supporting, and adjusting the panelboards and fronts. Cabinets shall be arranged to provide a wiring gutter not less than 3 inches wide for panelboards up to 31 inches high and not less than 4 inches wide for larger panelboards.

Lighting and power cabinets shall be installed with tops 6 feet 6 inches above floor, and telephone cabinets shall have bottom just above baseboard. Telephone and signal cabinets in ground floor shall be installed with tops 6 feet 6 inches above floor, unless otherwise noted on drawings. Those in finished spaces shall be set flush in walls and those on unfinished walls or where shown on drawings shall be set exposed. All cabinets shall be rigidly secured in place. All cabinets shall have fronts straight and plumb and arranged so that panelboards will be centered in door opening. Telephone cabinets over 30 inches wide shall have double doors.

Double-pole, 2 blade for 3 wire, single phase or 3 pole, 3 blade for 4 wire 3 phase, 250-volt switches with neutral connected to common busbar at top of panel will be acceptable for distribution panelboards when grounded neutral systems are installed.

The mains of panelboards shall be furnished with lugs only unless otherwise indicated.

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4.16 Safety type disconnecting switches: Safety type disconnecting switches shall be Type A enclosed, 230 volt unless otherwise noted, rated in horsepower capable of interrupting the locked rotor current of the motor for which it is to be used, which current will be assumed six times the rated full load current.

5.1 Feeders

5.11 Riser diagrams: Lighting and power feeders should be shown on a riser diagram giving the size of conduit, size and number of conductors and location of pull boxes, tape and terminals.

A tabular listing of feeders giving the size of conduit, size and number of conductors and description of terminal points may be used instead of detailing this information on the riser diagram.

5.12 Carrying capacity: Every feeder and subfeeder shall have a carrying capacity at least sufficient for the current corresponding to a maximum demand.

Compute the standard load for general illumination from the standard load in watts per sq. ft. and the area of the space served. Add to this load 1,000 watts for each circuit specified herein for purposes other than general illumination and 500 watts for each spare panelboard circuit, and any specific other load not otherwise included.

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5.13 Voltage drop: Feeders and subfeeders shall be of such size that, at a load corresponding to the maximum demand computed as stated above, the total voltage drop from the service entrance to any panelboard will not exceed 1.5 percent.

Provision shall be made for a future increase in the capacity of the feeder system to provide for a load of 1,500 watts on each 15-amp. branch circuit installed and such load on each heavy-duty lamp circuit as would result from changing the original lamps to lamps of the next larger size, so that, at such increased load, all feeders will have sufficient carrying capacity and the voltage drop will not exceed 1.5 percent.

CODE DEMAND FACTORS

The unit values and the demand factors herein are based on minimum load conditions, 100 per cent power factor, and may not provide sufficient capacity for the installation contemplated.

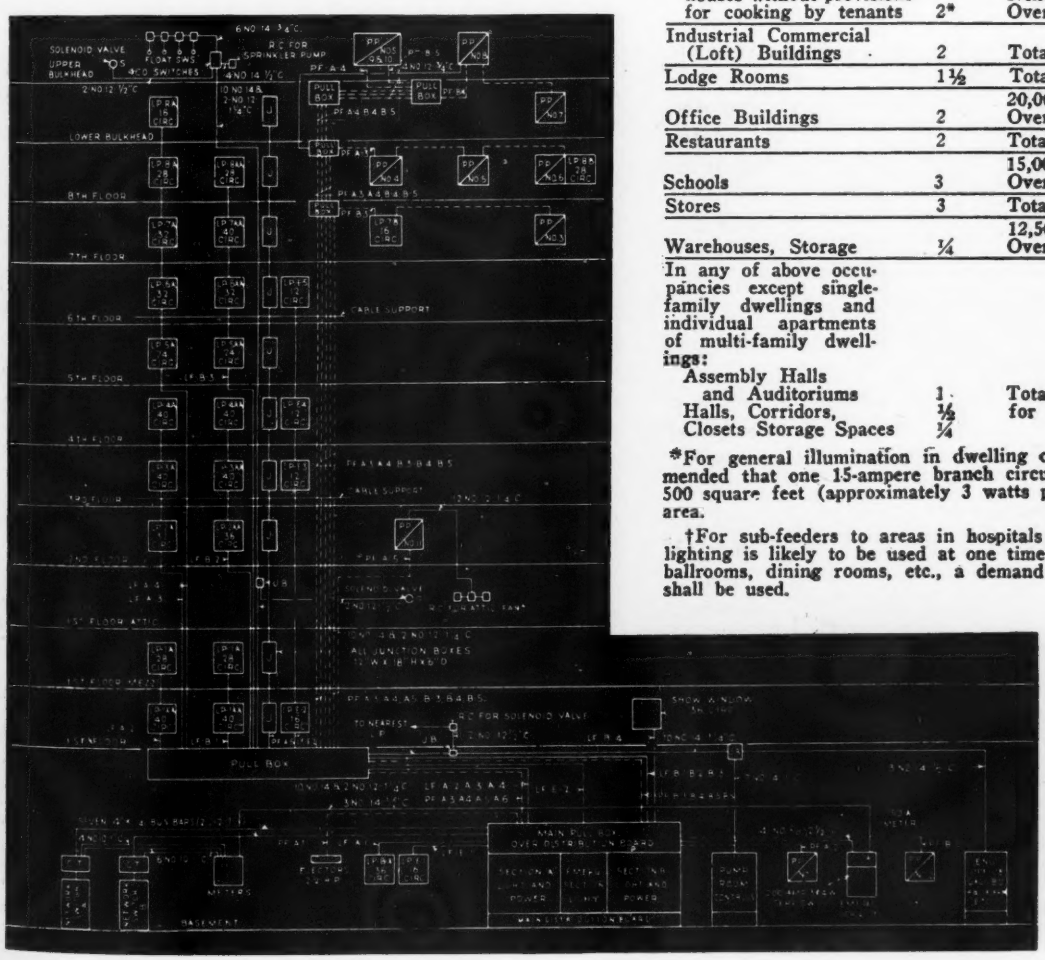
In view of the trend toward higher intensity lighting systems and increased loads due to more general use of fixed and portable appliances, each installation should be considered as to the load likely to be imposed and the capacity increased to insure safe operation.

Where electric discharge lighting systems are to be installed, high power-factor type should be used or the conductor capacity may need to be increased.

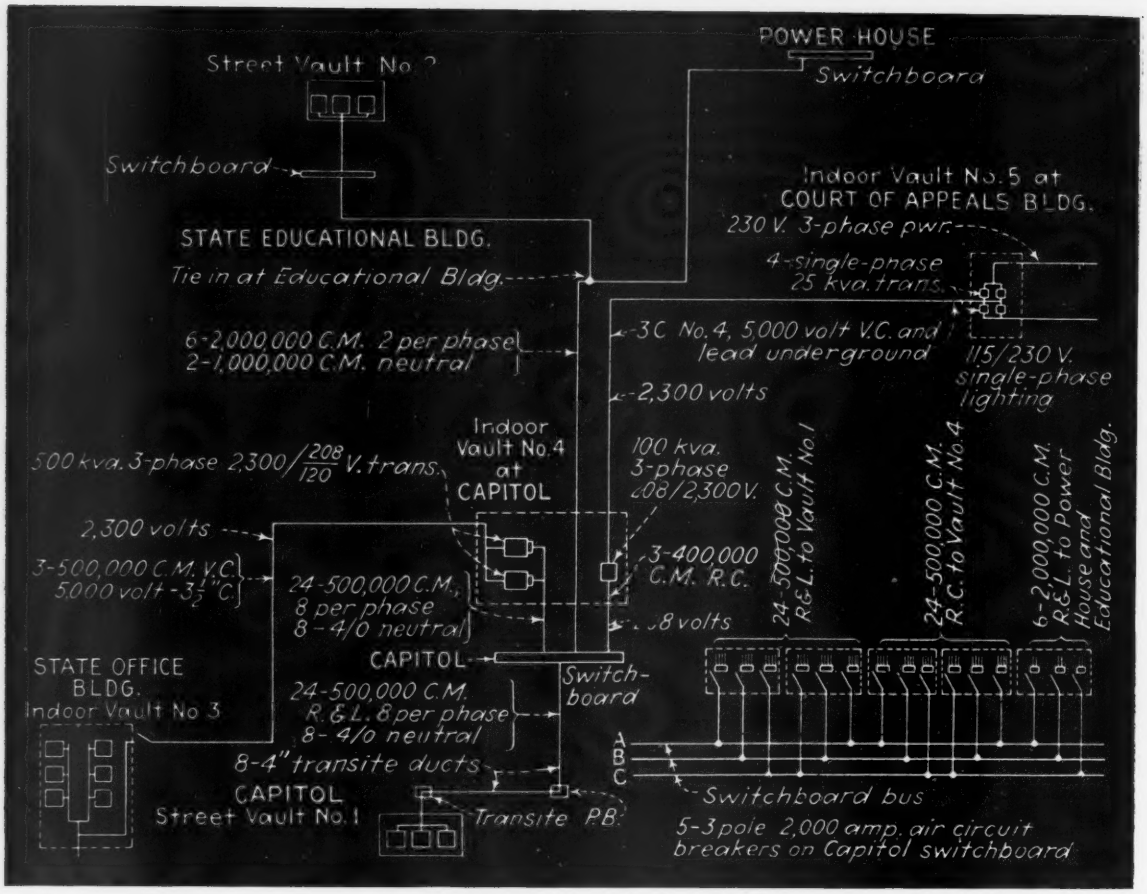
Type of Occupancy	COL. A Unit Load Per Sq. Ft. (Watts)	COL. B Load to which Demand Factor Applies (Watts)	Demand Factor
Armories and Auditoriums	1	Total Wattage	100%
Banks	2	Total Wattage	100%
Barber Shops and Beauty Parlors	3	Total Wattage	100%
Churches	1	Total Wattage	100%
Clubs	2*	Total Wattage	100%
Court Rooms	2	Total Wattage	100%
Dwellings— Single-Family	2*	2,500 or less Over 2,500	100% 30%
Dwellings— Multi-Family (other than Hotels)	2*	3,000 or less Next 117,000 Over 120,000	100% 35% 25%
Garages—Commercial (storage)	½	Total Wattage	100%
Hospitals	2	50,000 or less Over 50,000	40%† 20%
Hotels, including apartment houses without provisions for cooking by tenants	2*	20,000 or less Next 80,000 Over 100,000	50%† 40% 30%
Industrial Commercial (Loft) Buildings	2	Total Wattage	100%
Lodge Rooms	1½	Total Wattage	100%
Office Buildings	2	20,000 or less Over 20,000	100% 70%
Restaurants	2	Total Wattage	100%
Schools	3	15,000 or less Over 15,000	100% 50%
Stores	3	Total Wattage	100%
Warehouses, Storage	¼	12,500 or less Over 12,500	100% 50%
In any of above occupancies except single-family dwellings and individual apartments of multi-family dwellings:			
Assembly Halls and Auditoriums	1	Total Wattage as specified for the specific occupancy	
Halls, Corridors, Closets Storage Spaces	½ ¼		

***For general illumination in dwelling occupancies, it is recommended that one 15-ampere branch circuit be installed for each 500 square feet (approximately 3 watts per square foot) of floor area.**

†For sub-feeders to areas in hospitals and hotels where entire lighting is likely to be used at one time; as in operating rooms, ballrooms, dining rooms, etc., a demand factor of 100 per cent shall be used.



Riser diagram shows the feeders, switchboards, panels and major equipment items and their relationship in outline. Many details confusing on floor plans and difficult to describe in specifications can be clearly shown on this diagram.



Underground feeder diagram gives size of feeders and vault equipment.

(1) By installing feeders of excess size as a part of the original installation. This method shall be employed in every case where conductors not larger than No. 4 are required to meet the requirements for carrying capacity and voltage drop at the increased load.

(2) By installing oversize raceways, so that the conductors originally installed may be withdrawn at any time and replaced by conductors of suitable larger size.

(3) By making suitable provision so that additional feeders can be installed at a minimum of expense to provide the additional capacity.

Where either method (2) or method (3) is used, provision should be made at the feeder distribution center so that any larger feeders or new feeders installed can be properly controlled and protected without involving excessive expense for remodeling the original equipment.

Where method (3) is used, the system should be carefully designed so that the supplementary conductors can be used as separate feeders, not connected in multiple with the original conductors. Wherever these supplementary feeders must pass through walls, floors, or inaccessible places, suitable raceways should be installed when the original installation is made.

At feeder distribution centers, each feeder should be controlled and protected by a switch and fuses or by a circuit breaker.

Except where oversize feeders are provided in the original installation, provision should be made at the feeder distribution center for the connection and suitable protection of feeders of increased size or supplementary feeders, either by providing the additional protective devices as a part of the original installation or by so designing the original equipment that space, bus capacity and facilities for making connections will be available for the additional equipment.

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5.14 Conduits: Conduits shall be (galvanized rigid steel, electrical metallic tubing, or other raceway) of approved type and manufacture. They shall be installed as shown on the plans and the riser diagram in an approved manner. Joints shall be set up tight. Hangers and fastenings shall be secure and of a type appropriate in design and dimensions for the particular application. Runs shall be straight and true; elbows, offsets and bends shall be uniform and symmetrical. Installation workmanship shall be of the best quality and skill.

Wireways shall be an approved type and installed according to the recommendation of the manufacturer complete with the necessary fittings, connectors and parts.

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5.15 Wire and cable: Furnish and install wires and cables of the size and numbers shown on the riser diagram. Insulation shall be (specify whether rubber or thermoplastics, and the Code designation; R, RH, RU or T). For wet locations insulation shall be (specify whether rubber or thermoplastic and Code designation; RW or TW, or lead covered). No wires smaller than No. 12 shall be installed unless specifically designated.

Wires shall be approved types of building wire. They shall be suitably protected from weather or damage during storage and handling and shall be in first class condition when they are installed. Wires and cables shall be as made by ..... or equal as approved.

Raceways shall be complete before wires are installed.

Wires No. 6 and larger shall be connected to panels and apparatus by means of approved lugs or connectors. Connectors shall be solderless type, sufficiently large to enclose all strands of the conductor and securely fastened. They shall not loosen under vibration or normal strains.

Joints, taps and splices in wires larger than No. 6 shall be made by solderless connectors of an approved type and size. They shall be taped with approved rubber and friction tapes providing insulation not less than that of the conductor.

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5.16 Bus system feeders: Furnish and install as shown on the plans an enclosed busbar feeder system of the type and capacity noted. System shall be as manufactured by the ..... company. (Specify the particular design, whether conventional or low reactance type, the type of insulation, the type of housing and special details of support or installation.)

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5.17 Cable supports and boxes: Cable supports and boxes shall be installed for all vertical feeders in accordance with the schedule in the National Electrical Code. The cable support shall be of the split wedge type which clamps each individual conductor firmly, and tightens due to weight of cable.

No splices or joints will be permitted in either feeders or branches except at outlets or accessible junction boxes. Joints in branch circuit wiring shall be made mechanically and electrically secure. Unless properly insulated by the connector, all joints shall be taped with rubber and friction tape in a manner which shall make their insulation equal to the insulation of the conductors.

Conductors shall not be drawn into conduit until the plaster is dry and the conduit free from moisture. In drawing wires into conduits, allow sufficient slack to permit the connections of fixtures, switches, etc., without additional splices.

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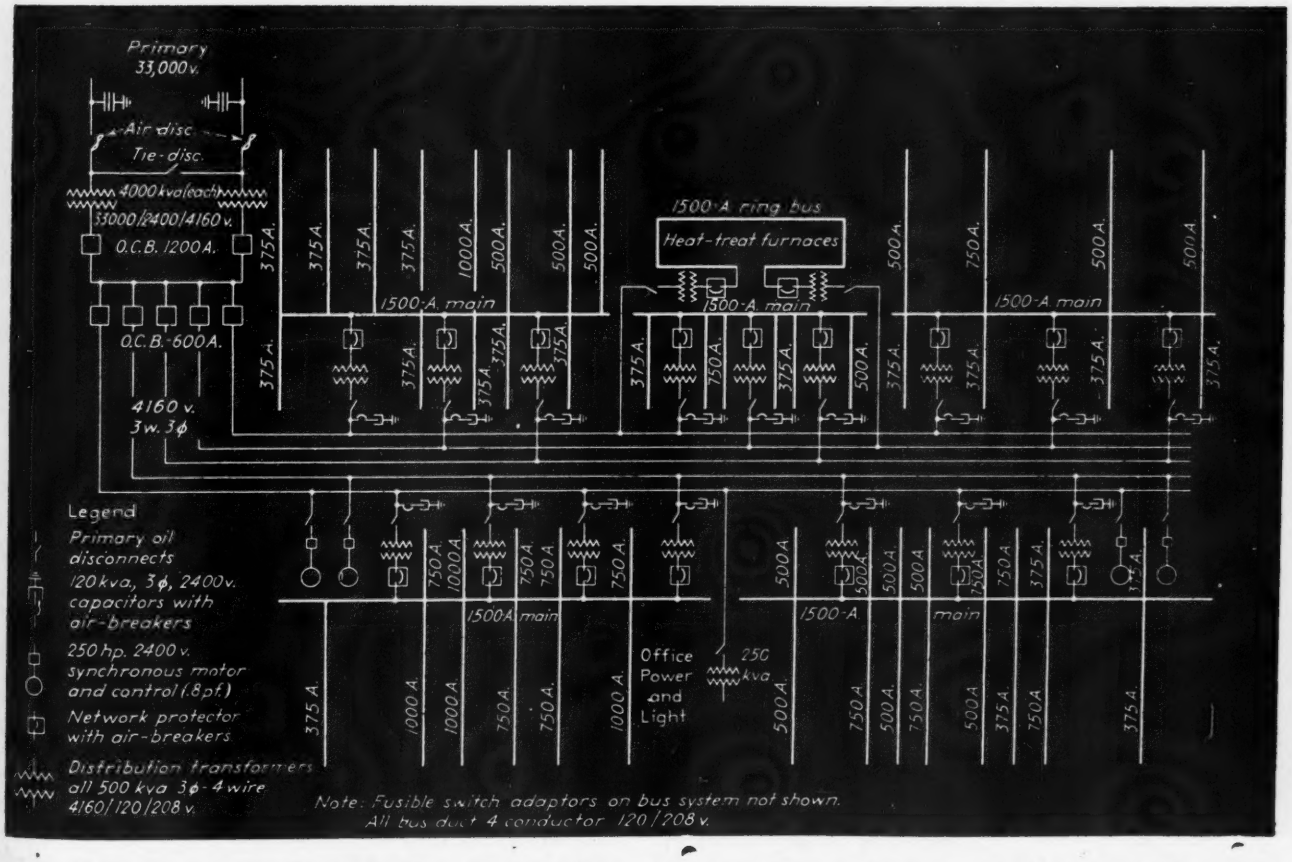
5.18 Underground distribution: Feeders and circuits installed underground require special considerations based upon the type of installation, soil conditions, possibility of damage and local practices.

Layout: Underground systems should be shown clearly on the plot plan. Runs should be direct and straight between manholes and terminal points, clear of roadways and separated from other underground systems particularly those requiring occasional maintenance or repairs.

Underground conduits: All conduits run underground shall be installed in (steel, fiber or asbestos-cement) conduits as specified or as indicated on drawings.

Conduits containing high voltage cables (over 600 volts) shall be installed not less than 30 inches below grade.

Trench shall be graded so that the conduits will have a



Primary feeder network and secondary bus distribution system shown diagrammatically give the electrical relationship between equipments and size of bus sections.

fall of at least 3 inches in 100 feet towards the lower manholes or from the high point of the section towards the manholes or from building towards manhole.

All conduits containing high voltage cables shall be enclosed in concrete not less than 3 inches beyond any surface of the conduit. Separators shall be used to secure a uniform spacing between conduits of not less than 2 inches. Concrete shall be 1-3-4 mixture.

The concrete envelope shall be reinforced at all points where conduits cross fill or loose soil, or water, gas or sewerage mains. Reinforcement shall consist of one ¾ inch reinforcing rod between each two ducts of bottom layer, and one rod laid at each lower corner of conduit envelope. Rods shall be laid parallel to conduits, centered between conduits and placed half way between bottom of conduit and bottom of concrete envelope. Reinforcing shall extend four feet beyond each end of fill or pipe main.

Fiber or asbestos-cement conduits shall be mandrelled to insure a smooth interior wall free from burrs or obstructions that will damage the cable. A No. 8 B and A galvanized steel drag wire shall be installed and left in all spare conduits not containing cables. All conduits shall be equipped with end bells where these conduits terminate in walls of building or manholes.

Manholes: Manholes shall be constructed of concrete with reinforced top and sides as indicated on drawings. Concrete shall be 1-2-4 mixture. Frames and covers shall be of cast iron, of sufficient strength for street loading and set to final grade as required. Provide pulling eye irons embedded in the opposite wall of each duct entrance to the manhole. Provide cable racks on walls spaced three feet on centers to accommodate the number of cables to be installed. End bells shall be provided in manholes for all conduit entrances. All manhole hardware shall be galvanized.

Each manhole shall have one driven ground rod, ¾ inch in diameter, 8 feet long, of hard drawn copper. The lead sheaths of all cables in manhole shall be grounded to this ground rod.

6:1 Branch Circuits

6.11 Where individual branch circuits are extended to equipment they may supply any loads. If two or more outlets are served they may supply only the following loads.

a. 15 and 20 ampere branch circuits may serve lighting and appliances. The rating of any one appliance may not exceed 80 percent of the rating. The total rating of fixed appliances may not exceed 50 percent of the rating if other lighting or appliances are also supplied.

b. 30 ampere branch circuits may serve lighting in other than dwellings or appliances. The rating of any one appliance may not exceed 24 amperes.

c. 50 ampere branch circuits may serve lighting in other than dwellings, fixed cooking appliances, fixed range and water heater or infra-red lamp industrial heating appliances.

Standard branch circuits are summarized in the following data from the 1946 code.

Circuit Rating	15 Amp.	20 Amp.	30 Amp.	50 Amp.
Conductors: (Min. Size)				
Circuit Wires	14	12	10	6
Taps	14	14	14	12
Overcurrent Protection	15 Amp.	20 Amp.	30 Amp.	50 Amp.
Outlet Devices: Lampholders Permitted	Any Type	Heavy Duty	Heavy Duty	Heavy Duty
Receptacle Rating	Max. 15 Amp.	20 Amp.	20 or 30 Amp.	50 Amp.
Maximum Load	15 Amp.	20 Amp.	30 Amp.	50 Amp.

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6.12 Lighting Circuits: The minimum number of branch circuits required for general illumination shall be based upon the standard loads. (See 9.1 Data tables.)

For two-wire 15 amp. circuits, the load per circuit should not exceed 1,000 watts.

For multi-wire 15-amp. circuits, the load should not exceed 1,000 watts between each outside wire of the circuit and the neutral wire.

For heavy-duty circuits, the maximum load per circuit depends upon the smallest size of wire used in the circuit and should be 1,500 watts for No. 10 and 3,000 watts for No. 8 or No. 6.

No wire smaller than No. 12 shall be used for any branch circuit. If the single distance from the panelboard to the first outlet exceeds 50 ft. the minimum size of wire for this run shall be No. 10 and the minimum size between outlets shall be No. 12. Panelboards should be so located that no run from the panelboard to the first outlet will exceed 100 ft.; if in special cases this distance must be exceeded, the loads should be reduced or the wire sizes increased to provide for a voltage drop not exceeding 2 percent at the last outlet. This paragraph applies to both two-wire circuits and multi-wire circuits.

Show windows: Branch circuit wiring shall be installed to outlets for show window lighting, the circuit capacities to be based upon the wattage specified.

Case lighting: Branch circuit wiring shall be installed to outlets for show case and wall case lighting, the circuit capacities to be based upon the wattage specified and the actual or probable lengths to be lighted.

Convenience outlets: All convenience outlets in walls or columns shall be provided with duplex receptacles unless otherwise indicated.

No convenience outlet shall be supplied by any two-wire circuit, or by any outside wire of a multi-wire circuit, that supplies one or more outlets for general illumination, show window outlets for general illumination, show window lighting or case lighting. Outlets for show window spot or floodlighting and convenience outlets in or near the floor in show window spaces shall be controlled separately from the outlets for show window illumination called for.

No wire smaller than No. 12 shall be used for any circuit supplying convenience outlets. Runs exceeding 100 feet in length from the panelboard to the first outlet should be avoided wherever practicable, but if unavoidable, such runs shall be not smaller than No. 10 wire and the wire between outlets shall be not smaller than No. 12.

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6.13 Wiring to Motors: It is preferable that a complete layout be made with one or more diagrams showing the method of wiring to each motor, the sizes of conductors for all feeders, subfeeders, taps and branch circuits and all raceway sizes. If this is done, the following should be used.

Wiring for motors and heating apparatus shall be installed in accordance with the accompanying wiring diagram.

If no detail drawing is used the following may be included in the specifications.

a. Each motor shall be supplied by an individual branch circuit from a distribution center. Conductors shall not be smaller than the minimum sizes permitted by the National Electrical Code and shall be of such size that the voltage drop from the distribution center to the motor will in no case exceed 1 percent when the motor is carrying its rated full load. Feeder conductors shall be of at least such size that the voltage drop from the service equipment to any distribution center will not exceed 3 percent when all motors are operating at their rated full load.

On exceptionally long motor circuits such as roof vent fans fed from basement panels the voltage drop of the circuit on the starting current of the motor should not be greater than 10 percent. A better practice is to feed such motors from nearby panels and operate by remote control circuits.

b. Motors shall be supplied through group subfeeders from distribution centers. Subfeeders shall either be brought direct to motor starters (or disconnecting means) or shall be connected to starters (or disconnecting means) by means of tap conductors. Subfeeders shall be of at least such size that when all motors are operating at full load the voltage drop from the distribution center to any motor starter will not exceed 2 percent. Feeders from service equipment to distribution centers shall be of at least such size that when all motors are operating at full load the voltage drop from the service equipment to any distribution center will not exceed 3 percent.

c. Motors shall be supplied by individual taps from the busbar distribution system.

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6.14 Branch circuits, residential: General purpose circuits (15 Ampere): General purpose circuits shall supply all lighting outlets throughout the home and all convenience outlets except the convenience outlets in the dining room, breakfast room, kitchen, pantry, and laundry. These shall be provided on the basis of one circuit for not more than each 400 sq. ft. of floor area. Outlets supplied by these circuits shall be divided equally among the circuits.

Appliance Circuits (20 Ampere) Two 20-ampere circuits for the convenience outlets in the kitchen, pantry, breakfast room, dining room, and laundry in a residence having a floor area of 1,500 square feet or less. The wiring for such circuits to be so installed that outlets supplied from both circuits are available in both the kitchen and the laundry. For residences with a floor area greater than 1,500 square feet one 20-ampere circuit for the convenience outlets in the kitchen, pantry, breakfast room, and dining room; one 20-ampere circuit for the convenience outlets in the laundry; and one 20-ampere circuit supplying convenience outlets in both the kitchen and the laundry.

The number of 20-ampere circuits required are necessary because new appliances are available, of high voltage, and with automatic features that make possible the performance of several household tasks simultaneously. The use of 3-wire circuits for supplying convenience outlets in the locations mentioned is suggested as an economical means for dividing load and offering practical operating advantages.

Individual Equipment Circuits

Circuits shall be provided for the following equipment:

Item	Capacity
Range (up to 12 Kw)	35A-3W-115/230V
Range (above 12 Kw)	50A-3W-115/230V
Fuel Fired Heating Equipment (if installed)	15A or 20A-115V
Dishwasher - Waste Disposer (if necessary plumbing is installed)	20A-2W-115V
Water heater	(Consult utility)
Automatic Washers	20A-2W-115V

Consideration should also be given to the circuit provisions for the following devices:

Item	Circuit
Clothes Dryer	25A-3W-115/230V
Cooling Fan	20A-2W-115V
Air Cooling Unit	25A-2W-230V
Home Freeze Unit	20A-2W-115V
Bathroom Heater	20A-2W-115V or 230V
Work shop or bench	20A-2W-115V

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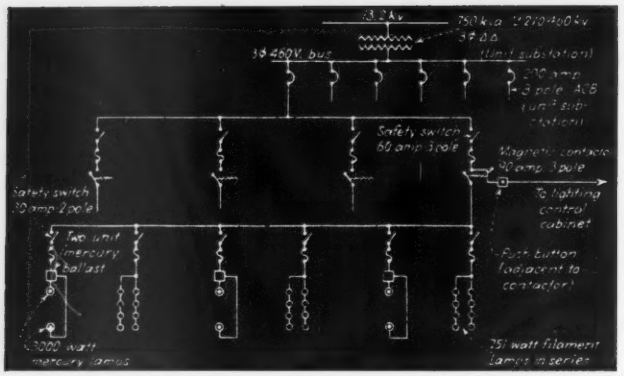
6.15 Methods of Wiring: State which of the following approved wiring methods shall be followed. Detailed installation requirements for each of these wiring methods will be found in the National Electrical Code.

Approved wiring methods commonly employed for new construction are:

a. Open wiring
b. Concealed knob-and-tube work
c. Conduit work
d. Surface metal raceways
e. Armored cable
f. Underfloor raceways
g. Non-metallic sheathed cable
h. Electrical metallic tubing
i. Wireways and busways
j. Bare busbars and risers
k. Non-metallic wiring systems for use in wet places.



One line circuit diagrams clarify complex lighting equipment hook ups such as this 460 volt mercury vapor and series incandescent circuit with remote switching.

Branch circuits shall be installed as shown on the floor plans. No wire smaller than No. 12 shall be used for any branch circuit unless otherwise noted on plans for special system circuits. Larger sizes shall be used where so indicated on the plans.

Outlets shall be located approximately as shown on the plans and shall be properly centered where located in panelled work or other special interior finish.

Wall switches shall be installed as shown on the plans and shall be connected to provide the control of outlets indicated on the plans.

Except as otherwise called for by the plans and specifications all receptacles shall be the standard flushduplex type rated at 15 amp. and 125 volts, adapted to receive standard 2-prong plugs.

The conductors terminating at each wired outlet shall be left not less than 8 in. long with their outlet fitting, to facilitate the installation of devices or fixtures. Where two or more pairs of conductors or circuits enter an outlet, the several pairs or circuits shall be neatly spliced and made mechanically and electrically secure to one or more single or multiple conductors, which conductors shall be not less than 8 in. long within the outlet.

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6.16 Specify the type of wiring systems to be employed, the raceways, and conductors and outlet boxes, indicating the quality, and any special feature of finish or grade.

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6.21 For all open wiring or knob-and-tube work as called for elsewhere in these specifications, furnish and install non-combustible, non-absorptive insulating bushings, cleats, knobs and tubes as manufactured by ..... or equal, and flexible non-metallic tubing as manufactured by ..... or equal.

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6.22 For all conduit work as called for elsewhere in these specifications furnish and install (select one or more types and state where each type shall be used:

galvanized rigid steel conduit,

corrosion resistive, non-ferrous alloy rigid conduit,

flexible metallic conduit.

All conduit, elbows and couplings shall be as manufactured by ..... or equal.

6.23 For all electrical metallic tubing work as called for elsewhere in these specifications furnish and install approved tubing as manufactured by..... or equal.

• • •

6.24 Furnish and install wireways as called for elsewhere in these specifications and as indicated on wiring plans, as manufactured by ..... or equal.

The cross-sectional area of wireways shall be .... in. by .... in. Covers and knockouts shall be provided in accordance with manufacturer's details.

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6.25 For all armored cable wiring as called for elsewhere in these specifications or shown on plans, furnish and install approved armored cable, properly bushed at ends and securely fastened to outlet boxes with approved connectors. Armored cable shall be of the best quality designed to offer a low resistance grounding path. Wires entering outlet boxes shall be not less than 8 inches long before stripping for joints or connections to devices. Armored cable shall be as manufactured by ..... or equal.

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6.26 For all non-metallic sheathed cable wiring as called for elsewhere in these specifications furnish and install approved tubing as manufactured by ..... or equal.

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6.31 Branch circuit conduits: Conduits shall be of sizes required to accommodate the number of conductors in accordance with the tables given in the 1946 edition of National Electrical Code or as noted on drawings. The minimum size of conduit shall be .... inch. Joints shall be cut square, reamed smooth and drawn up tight.

Concealed conduits shall be run in as direct a line and with as long bends as possible. Exposed conduits shall be run parallel to or at right angles with the lines of the building, and all bends shall be made with standard conduit ells, conduit bent to not less than the same radius or screw jointed conduit fittings, all bends shall be free from dents or flattening. Not more than the equivalent of four quarter bends shall be used in any run between terminals at cabinets, outlets, and junction or pull boxes. Boxes shall be located in accessible locations.

Conduits shall be continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes, and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Terminals of all conduits shall be furnished with locknuts and bushings. Plug the ends of each conduit with an approved cap or disc to prevent the entrance of foreign materials.

All terminals of electrical metallic tubing shall be provided with approved watertight fittings. Electrical metallic tubing shall not be used for wiring where the potential exceeds 600 volts.

So far as practicable, all exposed conduits shall be run without traps. Where dips are unavoidable a pull box shall be placed at each low point or a hole drilled in under side of conduit, to provide means of escape for any moisture which may tend to collect in the conduit. Conduit systems shall be completed before conductors

are drawn in. Where conduits must be run exposed, except as indicated in the plans, locations of the runs shall be subject to approval.

Considerations: On concealed conduit jobs exposed runs are usually installed where concealing would weaken structural features, slabs are too thin for the size of conduit required or in unfinished spaces.

MAXIMUM NUMBER OF CONDUCTORS IN BOXES

Deep Boxes

Box Dimensions Trade Size	Maximum Number of Conductors No. 14	No. 12	No. 10	No. 8
1-1/2 x 3-1/4 octagonal	5	5	4	0
1-1/2 x 4 octagonal	8	7	6	5
1-1/2 x 4 square	11	9	7	5
1-1/2 x 4-11/16 square	16	12	10	8
2-1/8 x 4-11/16 square	20	16	12	10
2 x 1-3/4 x 2-3/4	5	4	4	
2-1/2 x 1-3/4 x 2-3/4	6	6	5	
3 x 1-3/4 x 2-3/4	7	7	6	

Shallow Boxes of Less Than 1½" Depth

Box Dimensions Trade Size	Maximum Number of Conductors No. 14	No. 12	No. 10
3-1/4	4	4	3
4	6	6	4
4-11/16	8	6	6

Combinations

Size of Conductor	Free Space Within Box for Each Conductor
No. 14	2. cubic inches
No. 12	2.25 cubic inches
No. 10	2.5 cubic inches
No. 8	3. cubic inches

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6.32 Outlet Boxes: Boxes for ceiling and interior bracket lighting fixtures shall have fixture studs. All studs shall be in centers of boxes and shall be strongly secured.

Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.

Ceiling outlet boxes where conduit is concealed shall be not less than 4 inches in diameter by 1½ inches deep with plaster covers. Outlet boxes where conduit is exposed shall be screw jointed not less than 6 inches in diameter to provide a seat for fixture canopy. Where surface metal raceway is used outlets shall be of sufficient diameter to provide a seat for fixture canopy.

Outlet boxes for wall fixtures where conduit is concealed shall be deep type, 4 inches in diameter, and have covers with center opening 3 inches in diameter. Outlet boxes for bracket fixtures where conduit is exposed shall be screw jointed not less than 6 inches in diameter to provide a seat for fixture canopy.

Standard deep type concrete outlet boxes, shall be used where conduits enter sides in order to avoid steel reinforcing rods.

Outlet boxes for switches and plug receptacles in finished walls shall be of one piece standard gang boxes, 4 inches by 4 inches by 1½ inches deep for 1 device, 6⅞ inches by 4 inches by 1½ inches deep for 2 devices. They shall have covers with rectangular openings of proper size and shape. Outlet boxes for switches and plug receptacles on unfinished walls where same can not be concealed shall be set exposed, unless otherwise noted on plans, and where exposed shall be screw jointed with covers to fit the device.

All boxes shall be rigidly secured in position. All boxes, except on unfinished ceilings and walls, except outlets for extensions, and except where conduit is run exposed shall be so set that the front edge of box shall be flush with finished wall or ceiling line or not more than one-fourth inch back of same. Bracket outlets shall be set 6 feet 6 inches from floor. When located on columns or over doors they shall be set symmetrical with columns or door.

Wall switch outlets 4 feet 6 inches above floor shall be set flush in walls. When located near doors or windows they shall be close to trim. Plug receptacles shall be 12 inches above finished floor unless otherwise noted and set flush in walls.

Wall switch outlets shown at door locations shall be installed on the lock side of the door.

Outlet boxes for telephone, signal, pushbutton and buzzer outlets shall be about 4 inches square and shall have covers with rectangular opening in center. Each such outlet shall have a plate with ⅜ inch bushed opening in center.

Telephone wall outlets shall be set flush in wall 12 inches above finished floor unless otherwise noted. Signal outlets shall be flush in wall 12 inches above floor or near ceiling, as indicated by symbol or noted on drawing.

Outlets for clocks over doors shall be set so that when clock is installed same will center between top of door trim and ceiling. When there is no door they shall be set about 8 feet 6 inches above the floor. These dimensions may be varied if desired to suit architectural conditions. Outlets shall have boxes, covers, single-plug receptacles and wall plates similar to those elsewhere specified for duplex receptacles except that receptacle shall be recessed so that when plug is inserted it will be flush and allow clock to hang covering outlet. Suitable hook shall be provided to support clock. Where the clocks are installed under the same contract as the electrical system, and the voltage for the clock wiring does not exceed 50 volts, or where clocks operate on three wires the receptacles at clock outlets may be omitted.

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6.33 Junction or pull boxes: Junction or pull boxes not over 150 cubic inches in size shall be standard outlet boxes. Junction or pull boxes over 150 cubic inches in size shall be constructed same as cabinets, covers may be of same thickness as boxes and be secured by screws or bolts. All junction boxes shall be coated inside and out to prevent oxidation.

Junction boxes in main service conduits shall be ample size. All other junction boxes shall be not less than 4 inches square by 1½ inches deep. All junction boxes shall have closed covers and must be accessible after completion of the building. Junction boxes on concealed conduits shall be set with covers flush with finished plaster line, and on exposed conduits shall be set exposed, unless otherwise noted on drawings. Junction and pull boxes of sizes proportionate to the sizes of conduits or

conductors served shall be installed where shown on drawings, and where necessary or convenient for installing the wires.

Floor boxes: Floor boxes shall be of the watertight, adjustable type, arranged so that the top may be varied from the plane of its base. The boxes shall be approximately four inches in diameter by three and one-half inches deep. Each box shall be provided with a plug outlet or knockout as required. A gasket in a groove or an approved sealing cement shall be supplied between adjusting ring and body to make the box watertight.

Cover plates shall be of heavy brass with permanent ring or flange and rubber gasket. Brass cover plate shall have treaded hole approximately 1¾ inches in diameter, closed with flat plug in center. Covers shall be flush with the finished floor. For power outlets a receptable shall be installed. All boxes shall be furnished with an outlet nozzle with bushed outlet, and threaded to fit hole in cover plate.

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6.41 Flush Devices: Switches shall be flush tumbler type. They shall have a "T" rating of the National Board of Fire Underwriters Laboratories, unless otherwise noted on the drawings. Switches controlling ceiling outlets totaling 300 watts or over shall be 20 ampere rating at 125 volts. Switches shall be single pole, double pole, three way or four way as indicated by symbol on plans. Switches located in public spaces shall be lock type, key operated. Where more than one switch is shown at a point, they shall be set under one plate.

Mercury type flush switches: Switches shall be of the flush tumbler type designed for mounting in a standard outlet box. Switch shall have a hermetically sealed mercury button for making and breaking the circuit. They shall have a "T" rating of the National Board of Fire Underwriters Laboratories, 5 amperes 125 and 250 volts. Single pole and double pole switches shall have "Off" and "On" indicating markings on the operating handle.

Wall plates: Plates for each switch, receptacle, clock, signal and telephone outlet shall be (composition, brass, etc.).

Switches set in exposed screw jointed fittings or metal raceway for exposed wiring shall have plates to match the fitting and the edges of the plate shall be flush with the edges of the fitting.

Plug receptacles: Receptacles shall be flush type, 10 ampere, 250 volts except where otherwise noted on plans. All wall receptacles shall be duplex, and all floor box receptacles shall be of single type.

Combination fan hanger and receptacle: Provide a receptacle and hangar of suitable strength to support a 16-inch oscillating fan at all fan wall outlets. The receptacle shall be of standard type (single) and the hanger shall be secured to the outlet box by supports independent of the face plate or box cover. Outlet box shall be securely fastened in place. In all cases where conduit runs do not extend vertically through fan outlet provide a conduit nipple at least 12 inches long built into wall construction vertically and opposite the circuit conduit. Unless otherwise noted, fan outlets shall be 6 feet 10 inches from floor and shall be set to clear window trims or other obstructions by at least 12 inches.

Grounding receptacle: Receptacles for connection of groundable portable appliances shall be of the cord connector type with composition bodies, 3 pole, 20 ampere 250 volts, polarity-type, one pole for grounding of appliance.

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6.51 Busways and raceways:

Furnish and install as shown on the plans an enclosed busbar distribution system of the capacity indicated. The system shall be complete with all fittings, enclosures, insulating and supporting members as shown. System and parts shall be of the same manufacture and designed to be used together. Assembly and installation shall be made according to the manufacturer's recommended practice. The system shall be as manufactured by ..... Company or equal.

Installation should be detailed on plans and all bus capacities, taps and fittings noted. Specifications may include gage of metal, dimensions of bars, type of insulation, facilities for tap connections, and methods of attachment to building.

Furnish and install bus plugs at locations shown on the plans. Bus plugs shall be of the type and size designated and shall be of the same manufacture as the bus system and designed for use with it. (Specify disconnect, over current protection, capacity and type of raceway or cable connection required).

When busways are used on ungrounded system a potentializer plug should be installed to establish a definite potential to ground.

Multi-outlet assemblies: At locations shown on plans furnish and install multi-outlet assembly in one or more continuous sections. These sections shall consist of a metal race by having outlets to receive standard attachment plugs spaced.....in. apart. They shall be as manufactured by.....Company or equal.

For window and cove lighting reflectors furnish and install assemblies of metal raceway or wireway containing lamp receptacles connected on circuits as indicated on wiring plans. They shall be as manufactured by..... Company or equal.

Baseboard raceways: Furnish and install as called for elsewhere in these specifications and as indicated on the wiring plans a system of metallic baseboard wireways for (indicate whether single raceway for 115 volt service, single raceway for telephone and signalling service, or two parallel raceways forming two complete systems, one for 115 volt service and one for telephone and signalling service).

This system shall be installed complete with junction boxes, outlet fittings, cross-connected raceways, circuit conductors and wiring devices as indicated on plans. The system shall be manufactured by..... Company or equal.

Busway with movable contacts: Furnish and install busways and fittings as detailed on electrical plans for mobile device operations. Each section of busway shall have a capacity of ..... amp., and the mobile devices shall

make contact while in motion of not less than ..... amps. at any point along the length of busway. Mobile contact devices and busway shall be as manufactured by..... ..... Company or equal.

Cellular Steel Floor: Building construction (in the areas shown) consists of cellular steel floor of a type approved for use as raceways for electrical conductors.

Furnish and install all header ducts, end closures, feed connections, floor covering adapters, outlets, and taps as shown on the plans.

Cover plates, furnished by others, shall be brushed with cold flowing compound and attached to the floor by self tapping screws.

End closures shall be thoroughly sealed with tape and compound as recommended by the manufacturers.

Fittings and outlets shall be installed in an approved manner according to the practices recommended by the manufacturer.

Surface Raceways.

Furnish and install where indicated on plans surface metal raceways as made by.....Raceway, elbows, fittings and outlets shall be of the same manufacture and designed for use together. They shall be of a size approved for the number and size of wires installed. They shall be installed in an approved and workmanlike manner. Runs shall be parallel or at right angles to walls and partitions. Connections shall be made to other types of raceways in an approved manner with fittings manufactured for the purpose.

Underfloor Systems.

Furnish and install the underfloor duct systems as shown on the drawings.

Furnish and install all junction boxes, fittings, connectors and outlets as shown. Raceways and parts shall be as made by the ..... company and shall be all of the same type and manufacture and designed for use together.

Installation shall be made according to the practices recommended by the manufacturer and the best workmanship. Surfaces of covers where intended to be flush with furnished floor shall be level and true.

Outlets shown shall be installed and wired complete.

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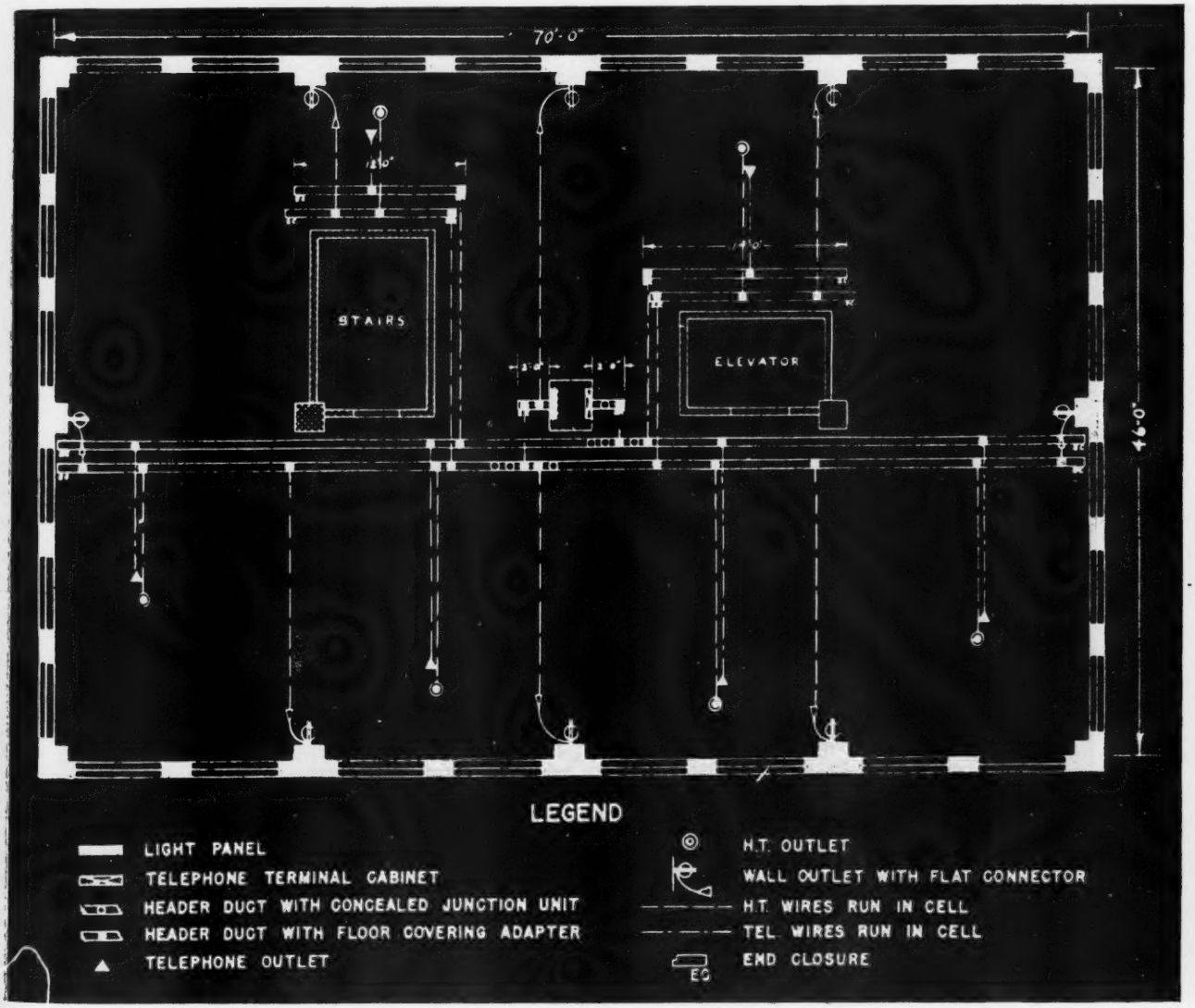
6.52 Hazardous locations: In areas indicated as hazardous or where required by the latest edition of the National Electrical Code, wiring shall be installed in ac-



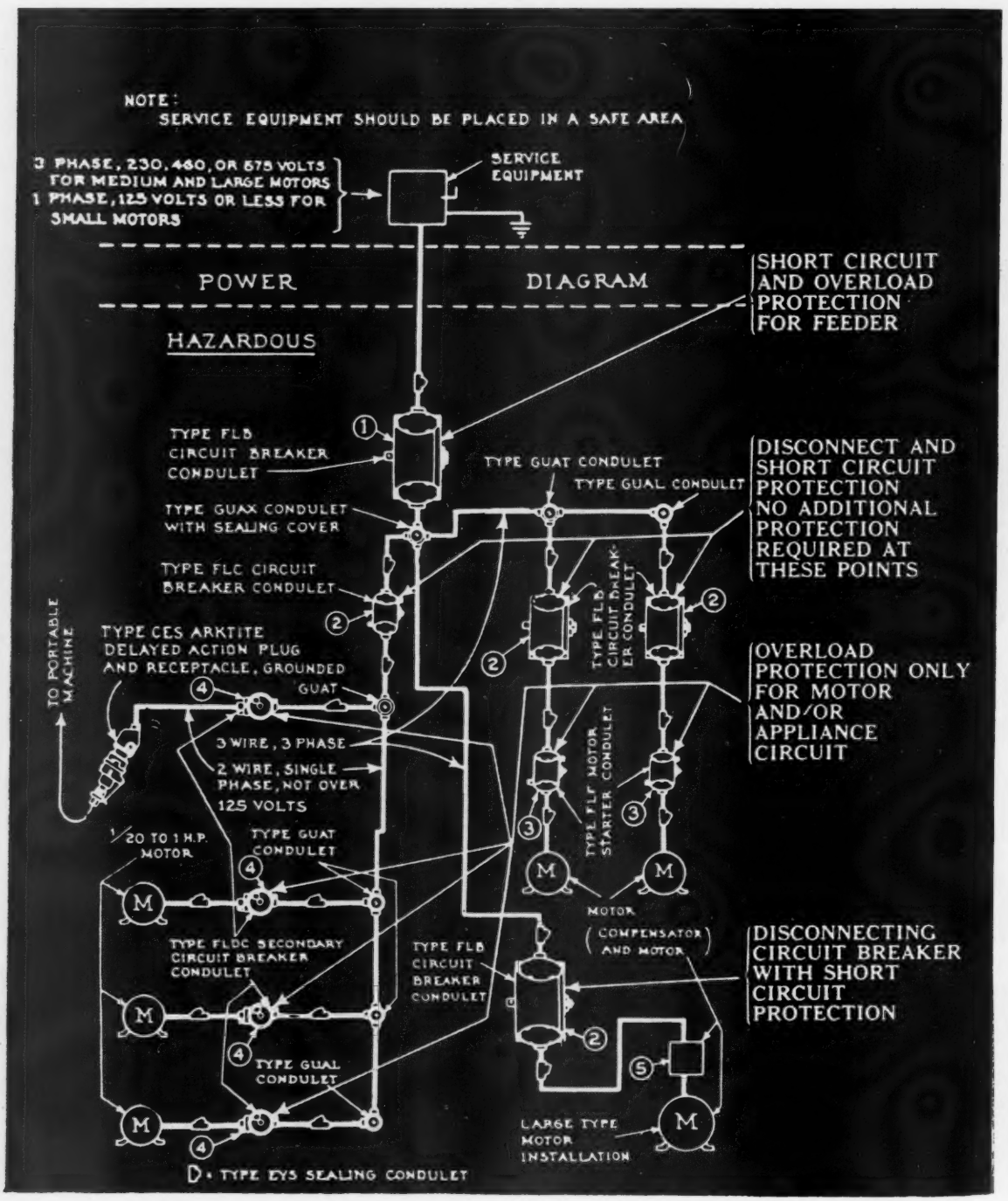
Cellular floor wiring systems are usually shown on separate floor plans indicating the header ducts cabinets and installed outlets.

cordance with the Code rules as they apply to hazardous areas. Materials shall be the best approved quality, specially designed and approved for the type of area and installation. Installation shall be made by mechanics thoroughly experienced in this type of work and workmanship shall be of the best quality and skill to assure maximum safety.

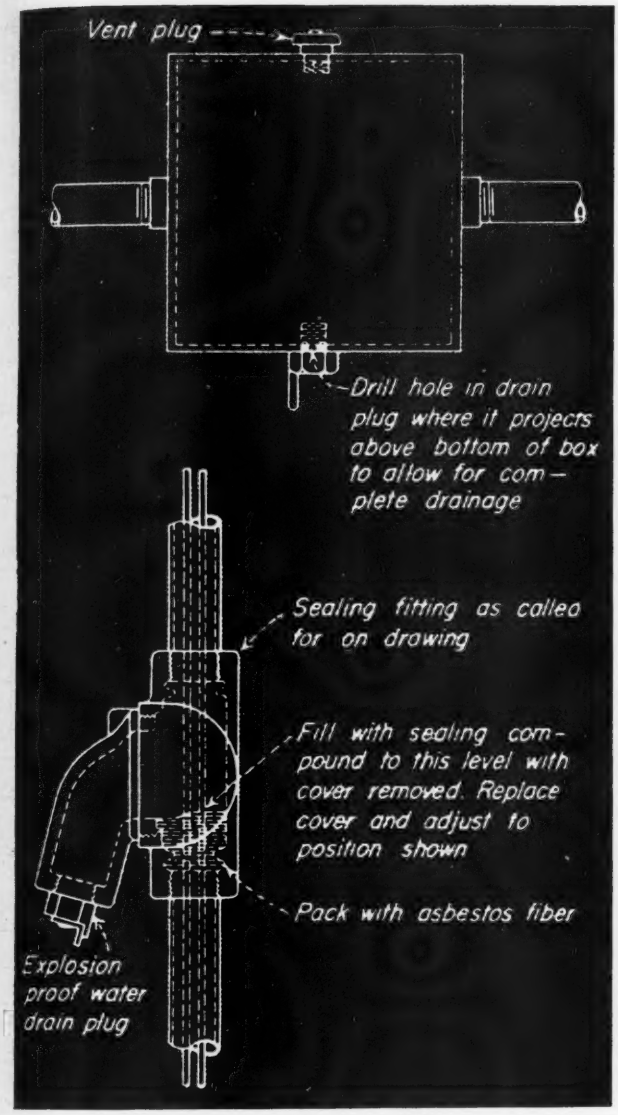
Note: Code rules for hazardous locations as they appear in the 1946 revision are given on pages 105 and 106 in this section. New rules designate areas in two divisions under each of three classes representing varying hazard conditions depending upon the operations performed on combustibles.

6.61 Emergency lighting systems: Emergency lighting systems are required by state laws, municipal ordinances, and by the National Electrical Code. While these requirements apply generally to theatres, moving picture shows, and other public gathering places, some states and cities have regulations which stipulate additional occupancies for which emergency lights must be provided, such as hotels, schools, factories, etc.

A. Two or more independent sources of supply.
B. Auxiliary current supply
1. Automatically charged batteries
2. Automatically started generators
3. Small non-compulsory emergency battery systems.



Hazardous area equipment layout shows the conduit, fitting, and apparatus. Simple one line block diagrams of hazardous area wiring systems are useful plan details.



Fittings designed to drain water from explosion-proof systems.

Emergency lights must be kept lighted during definite periods of occupancy or building use, and in case of failure in the normal current supply, must be automatically transferred without appreciable delay to an emergency source of current. The emergency lighting system must be capable of lighting, for a specified period of normal current supply failure, all exit signs, and also provide sufficient illumination to enable persons to leave a building safely.

In many local or state regulations, the number, location and wattages of lighting outlets are prescribed, also the types and the ampere-hour or full-load capacity of auxiliary emergency systems are set forth, stating the minimum voltages that may be applied to standard lamps.

Specifications for equipment and wiring layouts for emergency lighting systems should therefore be checked in detail with the inspection authorities having jurisdiction.

A. Two independent sources:

Where two or more separate and complete systems with independent current supply can be installed, each of these systems may supply a part of the emergency lighting provided all emergency lights supplied on each independent current supply system are lighted. The several supply systems may also serve all or a part of the general house lighting system.

Unless all the emergency lights served by two or more independent supply systems are kept lighted, a throwover switch must be provided which will automatically transfer the emergency lighting system from the normal to the emergency service in case of current failure.

B. Auxiliary current supply:

B-1. Auxiliary storage batteries of approved type and capacity may be provided instead of, or in addition to, System A. These batteries must also be provided with an automatic throwover switch, and they must further be automatically maintained at a fixed minimum state of charge. These systems normally operate at 105 to 120 volts.

B-2. Auxiliary generators with prime movers may be used in lieu of B-1, provided they are equipped with automatic controllers, and are capable of generating the energy required for the full emergency load within a certain reasonable time limit after a current failure occurs. .

a. Prime movers for driving auxiliary generators must be automatically started and may be

a-1. internal combustion engines,

a-2. steam driven engines,

a-3. steam or water driven turbines.

b. Automatic controllers must include approved storage batteries of the correct capacity for necessary cranking of the foregoing types of engines, or for operating the engine supply valves, as the case may be. When cranking batteries are employed, approved automatic charging devices must be provided for them. These generators commonly operate at 110 to 115 volts.

c. Automatic throwover switches, as called for in System A must also be provided for System B-2.

d. Auxiliary generators are sometimes permitted to be installed with sufficient capacity to supply all or part of the general lighting system, as well as the emergency lighting outlets prescribed by regulations.

B-1 and B-2. Approved warning or derangement signal devices of the audible or visual types must be provided for systems B-1 and B-2. These signals shall automatically give warning of a derangement of the emergency current sources, and shall indicate when batteries or a generator set are carrying the emergency illumination load.

B-3. Small emergency lighting systems are used voluntarily in banks, stores, factories and other places that are not required to provide emergency lighting systems. These systems are designed to supply through a storage battery a small number of specially equipped lighting units located in several important areas. A separate circuit is run from an automatic battery control panel to these lighting units. This circuit has no electrical connection with other normally supplied circuits. The automatic control panel usually consists of an automatic battery charging device and an automatic switch or relay for turning on the auxiliary lighting circuit whenever there is a failure in normal energy supply. A power supply connection must be provided between the control panel and the normal supply system for the throwover relay and for the battery charger. These systems usually operate at from 10 to 32 volts. Wiring must be designed for low voltage loss.

Installation.

a. All conductors for systems A, B-1 and B-2 are required to be installed in metal raceways or armored cable. No conductors of other feeders or branch circuit wiring shall be installed in the same raceways, outlet boxes, wireways or cabinets supplying the emergency lighting systems.

b. The service equipment for emergency lighting systems must be so connected that it will not be interrupted by the disconnecting of normal service equipment devices or by the functioning of normal service equipment over-current devices, except for the momentary delay while automatic throwover devices are functioning. Only the emergency service over-current devices shall be placed ahead of the emergency branch circuit over-current protective devices.

c. The switch for turning emergency lighting circuits "on" or "off" at the opening or closing of a theatre or other occupancy must, except as provided in paragraph d, be limited to one switch accessible only to authorized persons. This switch should preferably be located in the lobby or other place convenient to the main entrance of the building. This requirement will usually necessitate the installation of an emergency lighting panelboard that contains a remote-controlled master switch. A remote-control switch designed to operate this master switch can thus be placed in the lobby to meet the foregoing requirement. When the emergency lighting system only requires one to three branch circuits, a single or multi-pole switch can be provided in the lobby for directly controlling the several circuits. A feeder control switch for manually switching a group of emergency circuits from the lobby is not recommended, and in most cases requires a considerable increase in the length of the feeder conductors and raceway.

d. It is permissible to provide a separate switch for controlling one or more circuits supplying exterior emergency lights that are only needed during periods when there is not sufficient daylight. An automatic light-actuated control device may be used for this purpose.

System B-3 may involve runs of considerable length to scattered outlets. When low voltage auxiliary batteries are used, the conductors should be of adequate size to avoid excessive voltage losses and to prevent a corresponding reduction of illumination intensity. See Conductor Size table at left below.

Specify items of equipment as required for the system to be installed.

For system A, B-1 or B-2 (1) Automatic throwover switch, (2) Lobby control device or devices.

For System B-1 (1) Storage batteries, (2) Automatic battery charger, (3) Derangement signals.

For System B-2 (1) Generator and prime mover, (2) Automatic controller, (3) Cranking storage batteries, (4) Automatic battery charger, (5) Automatic valves, (6) Derangement signals.

For System M-3 (1) Automatic battery control, charging and relay panel, (2) Storage batteries, (3) Separate high-intensity low voltage emergency lighting units, (4) separate low voltgage branch circuit.

CONDUCTOR SIZE

Length of Circuit (One-way) Feet	Load in Amperes						
	1	2	4	6	7	8	10
SIZE WIRE ON 12 VOLT SYSTEM—Awg							
50	18	18	16	16	16	14	14
75	18	18	16	14	14	12	12
100	18	18	14	12	12	12	10
150	18	16	12	12	10	10	8
200	18	14	12	10	10	8	8
400	14	12	8	6	6	6	5
600	12	10	6	6	5	4	3
800	12	8	6	4	4	3	2
1000	10	8	5	3	3	2	1
SIZE WIRE ON 24 VOLT SYSTEM—Awg							
50	18	18	18	18	18	18	16
75	18	18	18	18	16	16	14
100	18	18	18	16	16	14	14
150	18	18	16	14	14	14	12
200	18	18	14	12	12	12	10
400	18	14	12	10	10	8	8
600	16	12	10	8	8	6	6
800	14	12	8	6	6	6	5
1000	14	10	8	6	6	5	4

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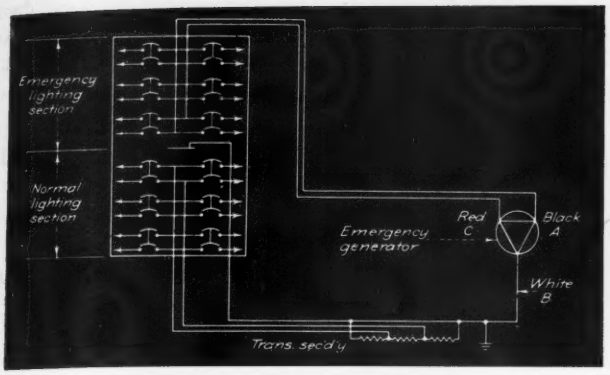
6.62 Emergency lighting unit: Furnish and install, in satisfactory operation, a complete emergency unit as indicated on the drawings. This unit shall consist of a storage battery, of a capacity sufficient for carrying the total emergency load for a period of two hours, a control panel for the storage battery arranged for operation in connection with current available at the building, and a suitable means for charging and maintaining the battery in a fully charged condition.

Storage battery: The storage battery shall consist of 60 cells, and shall be able to deliver amperes required for a period of two hours, when fully charged, to a final voltage of not less than 105 volts across the battery terminals.

Control cabinet: An automatic control cabinet shall be furnished. There shall be mounted in this cabinet a double pole automatic switch which will transfer the emergency circuit from the normal supply to the battery circuit upon failure of the normal supply and automatically will reconnect the emergency circuit to the normal supply when the service is restored. This automatic switch shall have a safe carrying capacity for the total connected load. It shall be so mounted that it will be accessible for the replacement of any parts or for making any adjustments.

On the face of the cabinet there shall be mounted a voltmeter, a milliammeter to read the charge rate and a switch for control of the emergency circuit.

Circuit protection shall be provided for protection of the normal supply circuit, and the charging device of the same type as specified for panelboards.



Split panel serving emergency lights.

A rectifier, capable of charging the 60 cell storage battery described above, in one series, shall be mounted in the cabinet in such a way that it will be accessible. It shall be designed for the current available and shall be capable of charging the battery at an approximately average rate of 4.6 amperes. This charger, when connected through proper resistance which shall be provided in the cabinet, shall be capable of trickle charging the battery at the proper rate, all equipment shall be left in operating condition.

Copies of instructions describing in detail the maintenance, care and operation of the equipment shall be furnished.

7.1 Signal, Communication and Auxillary Systems

7.11 Public Telephone Systems

A. Single station.

B. Main station with one or more extensions.

C. Private branch exchange.

D. Automatic private branch exchange.

E. Distribution system for a multiple occupancy building.

System A, B, C and D are treated here as entirely separate systems, each providing the entire telephone service for an individual subscriber. In a building occupied by a number of tenants, such, for example, as large office building, the service provided for any one tenant may consist of any one of the above systems A to D inclusive, and in such a case a distribution system extending throughout the entire building must be provided.

In any case except where the requirements can be met by System A or System B with one or two extensions, the engineers of the telephone company should be consulted and their advice should be followed in laying out the raceway system.

A. Single station.

In a commercial occupancy a single telephone will obviously be adequate only where the use of the telephone is infrequent or is confined chiefly to one person. System B is preferable in the majority of single family dwellings.

B. Main station with one or more extensions.

This system is suitable for use where a single incoming line is sufficient but it is convenient to be able to answer incoming calls or make outgoing calls from two or more locations. The system cannot be used for communicating between the two or more local stations without additional auxiliary equipment. It is not commonly used where the total number of stations exceeds three.

C. Private branch exchange.

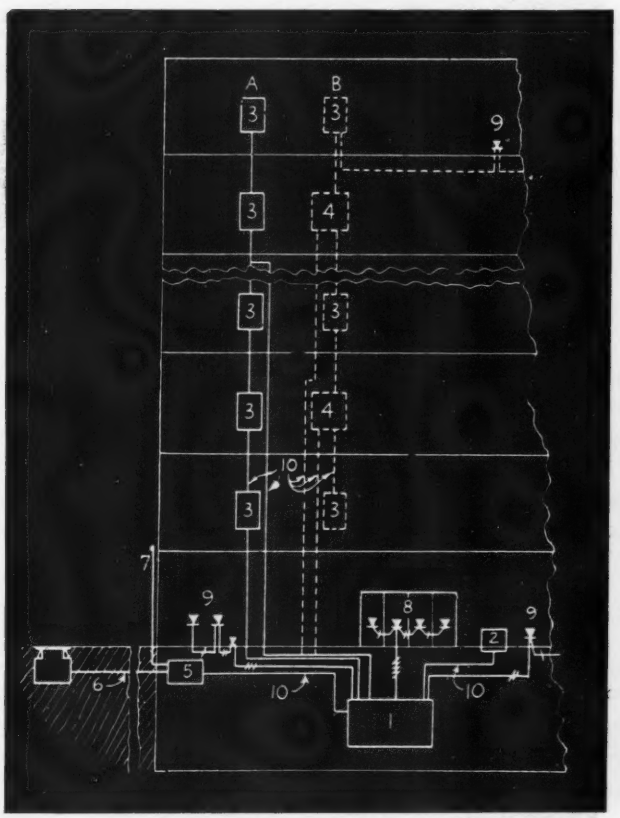
This system or System D should be selected where complete facilities for intercommunication and for making calls through the public telephone exchange are necessary. One or more operators must be on duty at all times when the system is in use.

D. Automatic private branch exchange.

This system provides the same service as System C but automatic equipment is employed. One or more operators are required to handle incoming calls but calls between the local stations and outside calls are made through the automatic equipment, hence for a large system the number of operators required is much less than for System C. The raceway system is the same as that required for System C.

E. Distribution system for a multiple-occupancy building.

Raceways for a telephone distribution system should be provided in every multiple-occupancy building where two or more tenants are to be served from a common service entrance. The distribution system raceways carry trunk



Telephone raceway system, 1—main cabinet, 2—central switchboard, 3—terminal cabinets, 4—terminal cabinet enlarged to house tap-off cable splice, 5—service cable junction box or service protector cabinet, 6—underground service raceways, 7—overhead service raceway, 8—booth outlets, 9—local telephone outlets, 10—raceways for cables.

lines from the service entrance to centrally located points on the various floors and from these points to the tenants' premises. So far as the demands can be anticipated, the raceway system in the tenants' spaces should provide sufficient flexibility of arrangement to accommodate any one of the four systems A, B, C or D that may be appropriate for the space a tenant occupies.

Telephone Conduits: Furnish and install a complete raceway system for telephone wires and cables, including

a-1. raceway for the service entrance terminating on the outside of building.

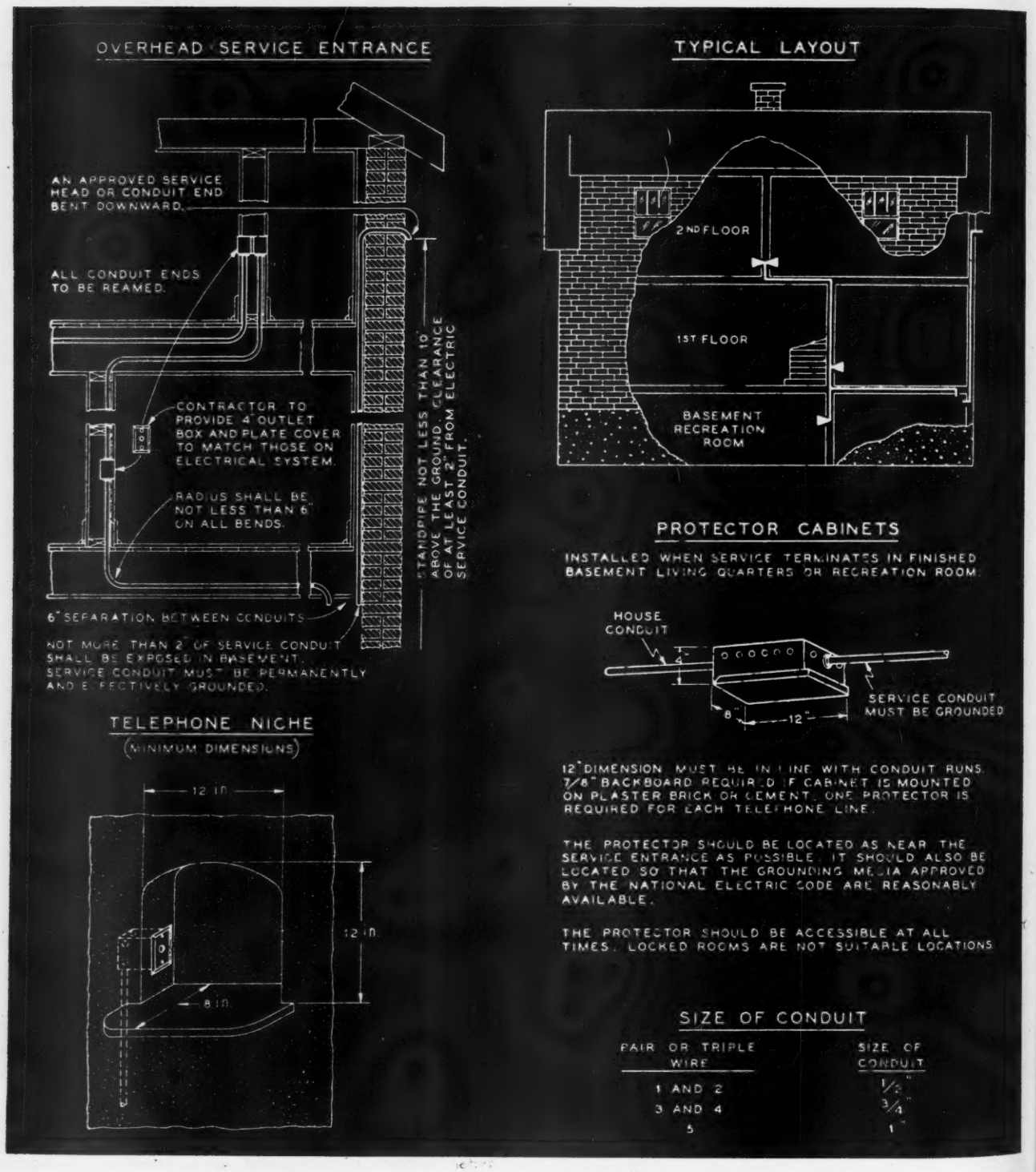
a-2. underground conduit from the telephone company's pole to the building as shown on the accompanying floor plans and riser diagram and in accordance with the requirements of the . . . . . Telephone Co. Telephone System.

A. (Where a single complete system will be provided.) The telephone system will consist of

a-1. a single station.

a-2. a main station with . . . . . extensions.

a-3. a private branch exchange switchboard system with . . . . . stations.



Telephone raceway system details for residence installations or other small buildings.

a-4. an automatic private branch exchange with ..... stations.

B. (For a multiple-occupancy building.) The raceway system will form part of a complete distribution system to provide telephone service for all tenants.

Raceways.

All raceways shall be rigid conduit or electrical metallic tubing, except that

a-1. surface metal raceway and

a-2. underfloor raceway shall be provided where shown on the plans,

b. and except that underground raceways shall be zinc coated rigid conduit. All raceway material shall be of make and grade as elsewhere specified. No run of raceway shall exceed 100 ft. in length. A No. 14 galvanized iron pull wire shall be inserted in each run of raceway. Specify the following equipment where required.

Outlet boxes—For all systems, for surface type wall telephones, flush type wall telephones, or desk type telephones.

Protector box—Required in every case except where the telephone company's distribution system is underground.

Pull boxes—May be required for any system.

Cross connection boxes—Usually required only for systems C, D, and E.

Terminal boxes—Required for systems C, D and E.

Splice boxes—May be required for systems C, D and E.

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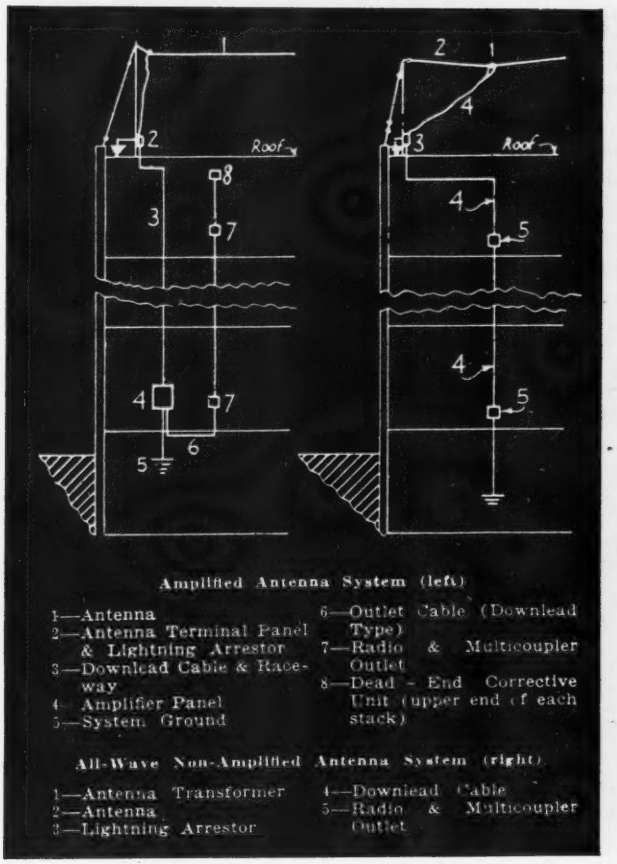

Amplified Antenna System (left)

1—Antenna
2—Antenna Terminal Panel & Lightning Arrestor
3—Downlead Cable & Raceway
4—Amplifier Panel
5—System Ground
6—Outlet Cable (Downlead Type)
7—Radio & Multicoupler Outlet
8—Dead - End Corrective Unit (upper end of each stack)

All-Wave Non-Amplified Antenna System (right)

1—Antenna Transformer
2—Antenna
3—Lightning Arrestor
4—Downlead Cable
5—Radio & Multicoupler Outlet

7.12 Radio antenna systems: For best results in radio reception the antenna system should be one of the following types:

(A) Doublet antenna with set couplers for all wave reception, for 1 to 25 sets.

(B) Antenna with amplifier and set couplers for broadcast band reception, for more than 25 sets.

Type (A).

The antenna consists of a stranded conductor (7 strands of No. 20 tinned copper or bronze) in two sections insulated from each other. A total length of 60 ft. to 80 ft. is recommended and a clearance of 10 ft. to 15 ft. above a roof, or, if not over a roof, a clearance of at least 30 ft. above the ground. The down-lead in a building of wood frame construction may be a No. 18 twisted pair installed in a manner similar to knob-and-tube work, a two-conductor No. 14 armored cable or a No. 18 twisted pair in metal raceway. In fireproof construction the downlead is a No. 18 twisted pair in metal raceway. Each outlet consists of a 4-in. square flush outlet box with 2-gang cover containing a set coupler and provided with a plate, a radio receptacle and a power receptacle.

Type (B).

The length and height of the antenna required for this system depends upon the number of receiving sets to be connected and the interference conditions. The length is often as much as 100 ft. and may be 150 ft. or even more. A height of 30 ft. or more above the roof is recommended. Each manufacturer of such a system has developed a special down-lead cable which is installed in metal raceway. The down-lead is first carried to a tube amplifier and from thence to the outlets. Outlet equipment is the same as for a Type (A) system, 2 gang cover plate, coupler radio receptacle and power receptacle.

Radio antenna systems: Furnish and install a (trade name or number) radio antenna system including outlets for ..... receiving sets, using equipment manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications.

Specify such of the following items as are required for the system selected, also the methods of installation:

(1) Antenna, antenna transformer, (2) Lightning arrester, (3) Down-lead conductors, (4) Amplifier, (5) Outlets and set couplers, and (6) Ground connections.

Television antenna systems: The advances of F. M., television and other radio services into the ultra high frequencies requires special facilities for radio installations. Sight line transmission characteristics of these frequencies and the need for skillful antenna design and location to avoid "ghosts" or reflections requires the installation of suitable raceways for transmission lines connecting the set to its antenna or the building antenna system.

Minimum requirements are a raceway system suitable for the future installation of coaxial transmission lines, outlets at each point of use and a weatherproof outlet on the roof.

Antenna raceway: Furnish and install a raceway system for future television antennas and transmission lines. At each television outlet indicated on the plans install a 4 inch square box with plaster cover and blank plate. From each outlet install (conduit or electrical metallic tubing) according to the following schedule

1 outlet	**½ inch**
2 outlets	**¾ inch**
3 outlets	**1 inch**

to a service entrance type weatherproof conduit fitting

extending 8 inches above the roof at the point indicated on the plans. Raceways shall be securely grounded to the water piping system.

Antenna System Raceway (for amplified distribution). Furnish and install a raceway system for future television antenna and amplified distribution system.

At each television outlet shown on plans furnish and install a 4 inch square box with plaster cover and blank plate. From each group of 10 outlets run a ¾ inch (conduit or tubing) to the distribution junction box located on the top floor. From the antenna junction box run a 2 inch conduit to a weatherproof service entrance fitting located on the roof at the point marked "television antenna."

A typical amplifier system includes

1. Group antenna or individual antennas for each station frequency.
2. Coaxial transmission lines from each antenna to the amplifier.
3. Amplifier consisting of individual amplifiers for each frequency.
4. Coaxial line or lines to receiver locations.
5. Set couplers at each outlet.

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7.13 Intercommunication telephone systems: The following are the more commonly used types of private telephone systems:

A. Two-station system.
B. Common ringing and common talking system.
C. Selective ringing and common talking system.
D. Selective ringing and selective talking system.
E. Selective ringing and selective talking system with master annunciator.
F. Private exchange manual switchboard system.
G. Private exchange automatic system.
H. Apartment house system, selective ringing and common talking, no janitor's station.
I. Apartment house system, selective ringing and common talking, with janitor's station.
J. Apartment house system, selective ringing and common talking, with janitor's and tradesmen's station.

A. Two-station system.

This system is suitable for use where communication is required between two stations only.

B. Common ringing and common talking system.

This system is suitable where a low-cost system is desired and the telephones will be used only infrequently. A prearranged code must be used for calling because the bells at all stations ring whenever a call is made.

C. Selective ringing and common talking system.

Any station can call and talk to any other station but only one conversation can be carried on at one time. This is a satisfactory system for use in a residence or in other occupancies where the system will be used only occasionally and where privacy is not necessary. About 12 stations is the practical limit for this system.

D. Selective ringing and selective talking system.

Any station can call any other station and as many conversations can be carried on at one time as there are pairs of stations. This system is suitable where a reasonable degree of privacy is desired or where the system will be used frequently and must always be available for instant service.

E. Selective ringing and selective talking system with master annunciator.

System E provides for communication between one master station and any number of outlying stations up to 100. Any station can call the master station. Each incoming call is registered on an annunciator at the master station, the attendant then plugs into a jack connected with the calling station and answers the call. The attendant can call any outlying station by plugging into the corresponding station and pressing a calling button. This system is quite commonly used in apartment buildings where a doorman is on duty at the main entrance.

F. Private exchange switchboard system.

A switchboard system provides complete intercommunication service and can be arranged for as many simultaneous conversations as desired. Such a system should be selected where the number of stations exceeds the practical limits of System D and where it will be practicable to provide an operator at all times when the telephone system is in use.

G. Private exchange automatic system.

This system provides the same service as System F and is similar in all respects except that the manually operated switchboard of System F is replaced by automatic equipment so that no operator is required.

H. Apartment house system, selective ringing and common talking, with no janitor's station.

This is a modification of System C which is suitable for use in an apartment building where no janitor is continuously on duty. A telephone is provided in the vestibule and in each apartment. A person in the vestibule can call and talk to any apartment. Each apartment telephone is provided with a pushbutton to operate the door opener and a pushbutton and bell or buzzer is provided at the front and rear door to each apartment.

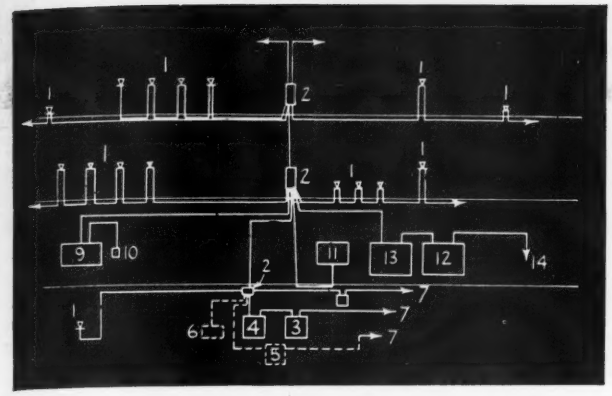
I. Apartment house system, selective ringing and common talking, with janitor's station.

System I is the same as System H except that it is intended for use where a janitor will be on duty continuously and includes a special station in the janitor's apartment. A person in the vestibule can call and talk to any apartment or the janitor. Any apartment can call and talk to the janitor and operate the door opener. The janitor can call and talk to any apartment and operate the door opener. A pushbutton and bell or buzzer is provided at the front and rear door to each apartment.

J. Apartment house system selective ringing and common talking, with janitor's station and tradesmen's station.

This system is similar to System I but includes a special station in the tradesmen's entrance. Calling and talking is the same as with System I and in addition a person in the tradesmen's entrance can call and talk to any apartment or the janitor. A pushbutton and buzzer is provided at the rear door to each apartment.

Furnish and install a (give here the descriptive designation of the system, such as "selective ringing common talking" and the manufacturer's name and catalog number) telephone system with .... stations located as shown on the plans. All telephones and other equipment, except raceways, outlet and junction boxes and single and twisted pair conductors shall be the product of (name of manufacturer) and the entire system shall be installed in conformity with the manufacturer's specifications.



Private Intercommunicating Telephones 1—Private telephone outlets, 2—Cross-connecting terminal cabinets, 3—Battery charger, 4—Storage batteries, 5—Power rectifying unit in place of 3 & 4, 6—Dry cell batteries in place of 3, 4 & 5, 7—Power supply to No. 3, No. 5 or No. 8, 8—Transformer, 9—Vestibule telephones, 10—Door opener, 11—Office switchboard (Ap't or hotel), 12—Automatic switchboard in place of Nos. 9, 10, & 11, 13—Cross-connecting frame for No. 12 (on large systems), 14—Circuit from motor-generator, when recommended for large systems.

Telephones.

a-1. All telephones shall be

a-2. As indicated on the plans, telephones shall be

b-1. surface wall type, Cat. No. . . . .

b-2. flush wall type, Cat. No. . . . .

b-3. disk type, Cat. No. . . . ., with separate ringer.

b-4. except that the vestibule telephone shall be Cat. No. . . . . the janitor's telephone shall be No. . . . . and the telephone in the tradesmen's entrance shall be No. . . . . .

Conductors.

All single and twisted pair conductors shall be rubber insulated and covered with a cotton braid saturated with a moisture-resistant compound. All cables shall be lead covered.

Wiring Method.

All conductors, including cables, shall be installed in (raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each station outlet in an outlet box suitable for the type of telephone to be installed.

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7.14 Sound systems: Types of systems include:

A. Elementary system.

A sound amplification system in its simplest form consists of three parts:

(1) An input device for supplying energy at audio frequencies to the amplifier,

(2) An audio-frequency amplifier,

(3) One or more devices or speakers to transform the audio-frequency energy into sound.

The primary device providing the input to the amplifier may be either:

a. A microphone, used for picking up sound vibrations, usually voice (talking or singing) or instrumental music.

b. A record reproducer. The record is most commonly in the form of a disc and the equipment is usually termed a phonograph. ("Sound-on-film" equipment is used almost universally in motion-picture work but is seldom employed in conjunction with other sound amplification systems.)

c. A radio receiving set.

The more important characteristics of the amplifier are its output capacity, rated in watts, and its fidelity. High fidelity involves freedom from objectional distortion and uniform amplification of all audio frequencies within reasonable limits.

Uniform amplification of all frequencies between 30 and 10,000 cycles per second is usually considered excellent performance. The necessary watts output of the amplifier depends upon the number and type of speakers to be supplied.

Speakers usually operate in multiple on amplifier circuits and are matched in impedance to the line and output transformer. Where speakers are installed in separate rooms it may be necessary to provide an individual volume control for each speaker.

Electrodynamic speakers are used where a high output and high fidelity is important. All speakers operated from one amplifier are connected in multiple and individual volume controls should usually be provided where speakers are in separate rooms. Provision must also be made for current supply to the field winding of each speaker; this field current may in some cases be supplied from the amplifier, or it may be necessary to provide for each speaker or for a group of speakers a power supply unit with a connection to the 110 volt wiring system.

Permanent magnet dynamic speakers are the most common types. They have the same characteristics as the electrodynamic type as regards fidelity and sound output but no provision is required for field excitation current. They are also used as a microphone in "talk back" intercommunication systems.

The simple type of sound amplification system having one or more input devices, a single amplifier and one or more speakers, has innumerable applications.

B. Multi-channel system.

A multi-channel system consists of a combination of two or more elementary systems, permitting two or more programs to be transmitted to each speaker station. A selector switch is provided at each speaker for selecting the designed program. As an example, a four-channel system might provide for reception from two different radio broadcasting stations, a program of addresses being delivered at a local meeting and received through a microphone, and a program reproduced from phonograph records. Multi-channel systems are quite commonly used in large hotels.

C. Sound intercommunications system.

The basic sound intercommunication system consists of a master station and one or more remote speakers. The master station includes the amplifier, speaker and switching controls. A "press to talk" switch connects the speaker as a microphone and a selector switch connect the individual outlying station. Upon release of the "talk" switch the called station is connected as a microphone and can answer.

By employing several master stations and switching methods, such systems can be adapted to a great variety of communication applications.

Wiring.

Microphone leads are always shielded cables whether installed in raceways or not. Multiple channel sound circuits and sound intercommunication leads to speakers are preferably shielded pairs especially where more than

one circuit is installed in the same raceway.

Speaker field circuits should be installed according to the same specifications as power and light wiring. They should not be installed in the same raceways with amplifier output lines.

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7.15 General paging system: Type of systems include:

A. Central Manual Signalling

1. To one or more outlying signals operating simultaneously.

2. To one or more outlying signals, operated individually or in sub-divided groups.

B. Central mechanical code calling

1. To several outlying signals operating simultaneously.

2. To several outlying signals operated individually or in sub-divided groups.

A. Central manual signalling.

This system is as fundamentally an arrangement of one or more pushbuttons for controlling signalling circuits leading to audible or visual signals located in outlying rooms or areas. With system A-1 the signalling procedure would require a predetermined code for paging one of two or more persons from any part of a building. With system A-2 the same procedure would usually be followed, excepting that the operation of signals could be limited to subdivided portions of large buildings as desired.

B. Control mechanical code signalling.

This system is used for transmitting a predetermined series of signalling impulses to several locations over a sustained period of time by means of mechanical devices. Coded signals are transmitted without further attention until the paged person responds, or until the transmitter is stopped, or until it has completed a definite cycle of impulse transmittance.

A transmitter unit is usually placed near the telephone switchboard operator. This transmitter may be a selector keyboard for operating a separate set of relays, or it may be a mechanically driven device for the direct switching of coded impulses without using relays.

Signal devices for A or B systems may be bells, buzzers, chimes, gongs, horns, howlers, sirens, whistles or visual types, provided such devices are selected to operate efficiently on the impulses transmitted by the equipment chosen. Large sirens, and large air valve whistles operating at 110 or 220 volts require special relays especially if low-voltage paging impulse equipment is used. When B-1 or B-2 systems are operated from transformers, a separate 110 volt connection must be provided for some makes of selector relays and motor drives.

Installation.

Provide two conductors from the signalling location to all signal devices of system A-1. Add one conductor for each sub-division of signal devices as in system A-2. Provide conductors between the selector relays and the signal devices of systems B-1 and B-2 as called for under systems A-1 and A-2 above. The number of conductors to be provided between selector keyboards and relay cabinets shall be determined from the manufacturer's system wiring diagram.

Furnish and install a (trade name or number) general paging system as indicated on wiring plans, as manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications.

Conductors

All conductors for 110 volt systems shall be not less than No. 14. They shall have 600 volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

Wiring Methods

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed.) Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

Equipment

Specify such of the following items as are required for the system selected:

(1) Selector; (2) Selector relay panel; (3) Non-relay type) Impulse transmitting device; (4) Flexible cable; (5) Transformer; (6) Audible signals; (7) Visual signals.

GROUPED SINGLE CONDUCTORS

Number of Conductors	No. 18* ☆' RB	No. 18 ☆' RB	No. 16* ☆' RB	No. 16 ☆' RB	No. 14 ☆' RB	No. 12 ☆' RB	No. 10 ☆' RB
	Conduit Size—Inch						
5	½	½	½	½	¾	¾	1
10	½	½	½	¾	1	1¼	1¼
11	½	½	¾	¾	1	1¼	1¼
12	½	½	¾	¾	1¼	1¼	1¼
15	½	¾	¾	1	1¼	1¼	1½
16	½	¾	¾	1	1¼	1½	1½
20	¾	¾	¾	1	1½	1½	2
24	¾	1	1	1¼	1½	2	2
25	¾	1	1	1¼	1½	2	2
30	¾	1	1	1¼	2	2	2½
35	1	1	1¼	1¼	2	2½	2½
40	1	1¼	1¼	1¼	2	2½	3
45	1¼	1¼	1¼	1½	1½	2½	3
50	1¼	1¼	1¼	1½	2½	2½	3
55	1¼	1¼	1¼	1½	2½	3	3
60	1¼	1¼	1¼	2	2½	3	3
70	1¼	1½	1¼	2	3	3	...
80	1¼	1½	1½	2	3	...	...
90	1¼	2	1½	2	3	...	...
100	1¼	2	2	2½	3½	...	...

RB—Rubber covered with protective braid.
*Approved by special permission only.

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7.16 Fire alarm system: types of systems include:

A. Open-circuit, non-code, non-supervised

B. Closed-circuit, non-code, supervised

C. Closed-circuit, box code, supervised

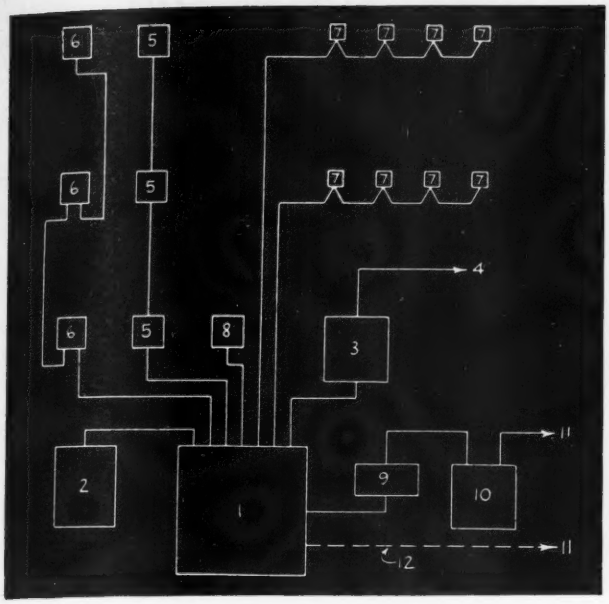
D. Closed-circuit, pre-signal, box code, supervised

E. Closed-circuit, box code, supervised system with connection to Fire Department

F. Automatic.

A. Open-circuit, non-code, non-supervised system.

When any station is operated, a general non-coded alarm is sounded on all gongs. This system is open to



Fire Alarm System 1—Control panel, 2—Master alarm station, 3—Fire dep't. alarm box, 4—Connection to fire dep't. system, 5—Alarm stations, 6—Alarm devices, 7—Thermal detectors, 8—Trouble bell, 9—Batteries, 10—Battery charger, 11—Power supply, 12—Power supply direct instead of No. 9 and No. 10.

the objection of all open-circuit systems that if through failure of the power supply or for other reason the system becomes inoperative, there is no means of ascertaining this condition other than by making a test at each station, i.e., it is inherently a non-supervised system. It is not recognized by the National Board of Fire Underwriters as an "approved" system. Only a small number of alarm devices can be operated on this system without a relay control panel. If the number of devices on the system is such as to require a control panel, a closed-circuit system should be specified as the cost will be only a very little greater.

B. Closed-circuit, non-code, supervised system.

Operation of any station sounds a general alarm six times on all gongs. If there is a failure of the power supply or the circuit is opened at any point, a small trouble bell rings continuously. This system is much more dependable than a non-supervised open-circuit system. It is suitable for use in buildings where there will not be so many occupants that a general alarm may cause a panic.

C. Closed-circuit, box-code, supervised system.

When any station is operated, a coded signal identifying that particular station is sounded on all gongs, usually four times in succession. Being a closed circuit supervised system it provides the maximum of dependability and is suitable for any building where there is an advantage in having a coded signal and where there is no objection to sounding a general alarm whenever a station is operated. The gong circuits are usually operated through relays on a central control panel. Disarrangement of the system is indicated by a trouble bell, as in System B.

D. Closed-circuit, box code, pre-signal supervised system.

In this system the operation of any station sends a coded signal through a relay control panel to one or more pre-signal bells; these may be installed at any desired location. It is then the duty of an attendant to make an investigation and, if necessary, turn in a general alarm. The general alarm may be turned in from any alarm box by inserting a key. A trouble bell is provided as in System B and C. This system is suitable for hospitals, hotels, department stores, institutions, places of public assembly and other buildings where it is not advisable to sound a general alarm until an investigation has been made and such action found necessary.

A pre-signal system may also include a relay to operate a special fire department alarm box.

E. Closed-circuit, box code, supervised system with connection to fire department system.

This system is the same as System C with the addition of a relay on the control panel connected to a special fire department alarm box. Operation of any station sounds a coded signal on all gongs and at the same time sends an alarm on the municipal fire department alarm system. By inserting a key in any box the station can be operated for fire drills without operating the fire department system.

WIRING DATA FOR FIRE ALARM SYSTEMS

System	Station Connection	Gong Connection	Siren Connection	Size Wire Gage No.	No. of Wires
A. Open-circuit, non-code	Multiple	Multiple	Multiple	14	2
B. Closed-circuit, non-code	Multiple	Series	Series	14	2
C. Closed-circuit, box code	Series	Series	Series	14	2
D. Closed-circuit, pre-signal	Series	Series	Series	14	4
E. Closed-circuit, connected to fire department system	Series	Series	Series	14	2
F. Automatic	Series	Series	Series	14	2

F. Automatic fire alarm system.

In the automatic fire alarm system, thermal detectors are installed at suitable locations, usually on the ceilings of the spaces to be protected. When the temperature at any device exceeds a predetermined limit, the circuit is opened and an alarm is sounded through a control panel. Reliable systems of this type are closed-circuit and supervised.

Fire alarm systems: Furnish and install a (give the description designation of the system, manufacturer's name and catalog number) fire alarm system including ..... alarm stations and ..... alarm devices located as shown on the plans. The system is to be 110-120 volt a-c. All equipment except standard wiring materials shall be the product of (name of manufacturer). The entire system shall be installed in conformity with the manufacturer's specifications.

Conductors—

All conductors shall be No. 14, and shall have 600 volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

Wiring method—

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet for an alarm station or alarm device in an outlet box suitable for the equipment for which the outlet is intended.

Equipment—

Specify items of equipment as required for the system to be installed:

Alarm stations:

Systems A, B—Hammer type break-glass station, flush or surface type. Hammerless type break-glass station, flush or surface type, maximum 20 per circuit.

Systems, C, D, E—Open-door pull-lever type, semi-flush or surface; break-glass pull-lever type, semi-flush or surface. Specify that all alarm stations shall be mounted 4 ft. 6 in. above floor, maximum 20 per circuit.

Special Fire Department alarm box:

Required for System E and may also be added to System D.

Alarm devices:

System A—Vibrating gongs, 8 in. 10 in. or 12 in., maximum 15 per circuit. Sirens—maximum 10 per circuit.

Systems B, C, D, E, F—Single-stroke gongs, 8 in., 10 in., or 12 in., 10 per circuit. Sirens—maximum 10 per circuit.

In general, gongs and sirens should be mounted 12 ft. above the finished floor or as near this height as the ceiling height will permit.

Control panel:

Required for all systems except A systems having only a small number of alarm devices.

Trouble bell:

Required for all supervised systems, B, C, D, E, F. Specify 3 in. or 4 in.

Thermal detectors:

Required for System F. Specify manufacturer's name and catalog number, spaces to be so equipped, maximum allowable spacing between outlets and maximum number of outlets to be wired on one circuit.

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7.17 Doctors' paging systems: Typical systems include:

A. Lamp annunciators

B. Lamp flashing signals

1. Single-call type
2. Multi-call type

C. In-and-out recorders.

A. Lamp annunciators: This is a simple system of lamp annunciators located on various floors operated from a fixed or portable plugging or switching device at the telephone switchboard. The quantity of numbered lamps and switch keys is governed by the size of the hospital staff. Such systems may include an audible auxiliary signalling device.

Lamps must be flashed manually.

B. Lamp signal

1. Single-call type.

This system is designed for paging one doctor at a time from the telephone switchboard room or other central location. One or more lamp annunciators, arranged with or without auxiliary audible signals, are provided with indicating numerals. The annunciators are controlled by a central keyboard and flasher equipment. Numerals as are assigned will provide for the individual paging of a staff of 120 doctors. The lamps are flashed automatically for a definite time cycle or until the doctor responds.

2. Multi-call flashing signals.

This system is designed for a total staff of 120 doctors, and is limited to simultaneous paging of three doctors as a general maximum. The equipment is essentially the same as for system B-1, except that more conductors are required.

Systems B-1 and B-2 usually employ a mobile selector keyboard and flexible multi-conductor cable connections to a fixed floor or wall outlet. Raceways are provided from the fixed outlet to a flasher and relay cabinet. The various circuit raceways are routed from the relay cabinet to all annunciators. In buildings which require several annunciators per floor, as at wings, a system of terminal cabinets may be found desirable for routing runs that lead away from a central riser point. These systems are commonly operated on 110 volts.

C. In-and-out recorders

This system is identical in principle and design to system A except that no audible signal is employed. Its purpose is to provide a lamp annunciator at one or more locations in a hospital to indicate the presence of certain staff doctors. The plugging or switching device may be portable or fixed and should be located at the most convenient place for doctors to "check" in and out, otherwise at the telephone switchboard. Because certain doctors are present for extended periods of time, thus requiring their lamps in the various annunciators to be left on for a like period, the type of lamps and their operating voltage should be selected for maximum life.

Doctors' Paging System: Furnish and install for doctors' paging system a (trade name or number) (insert, A, B-1, B-2, and/or C system designation) as indicated on

SINGLE TELEPHONE CABLE

Number of Conductors	Braided*		Leaded*	
	Overall Diam.	Conduit Size	Overall Diam.	Conduit Size
	Inch	Inch	Inch	Inch
6	0.26	½	0.30	½
11	0.28	½	0.33	½
16	0.31	½	0.36	½
26	0.36	½	0.40	¾
35	0.40	¾	0.45	¾
45	0.44	¾	0.48	¾
55	0.46	¾	0.51	¾
65	0.51	¾	0.55	1
75	0.53	1	0.57	1
85	0.55	1	0.60	1
100	0.60	1	0.64	1

*Number of Single No. 22 & 4 Single No. 18.

wiring plans, as manufactured by (name of manufacturer) all of which shall be installed in accordance with manufacturer's specifications.

Conductors—

All conductors shall be No. .... ga., and shall have 600 volt insulation of a type suited to the locations and conditions. They shall be of the make and grade as elsewhere specified.

Wiring method—

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

Equipment—

Specify items of equipment as required.

(1) Annunciators, with or without audible signals; (2) Selector keyboard; (3) Plugging or switching device; (4) Relay and flashing panel; (5) Terminal cabinet; (6) Flexible multi-conductor control cable; (7) Transformer; and (8) Special outlet boxes.

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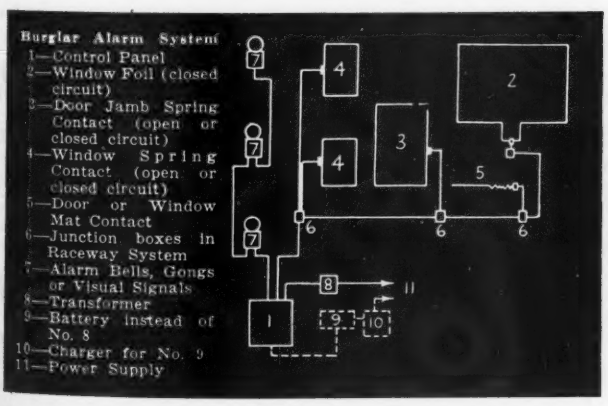
7.18 Burglar alarm systems: A burglar alarm system consists essentially of one or more contact making devices designed to operate circuits which will actuate one or more alarm devices. These alarm devices may all be located on the premises, or a leased wire connection may be provided to a central office.

Contact devices may be (1) manually operable in an emergency by pushing buttons, tripping the levers of switches, or by depressing hinged contact bars or floor treadles, or (2) automatically operated by means of: concealed contact making springs at doors, gates and windows; stair tread contacts; special locks on doors, cages and vaults; continuous circuits of foil applied to plate glass; or photronic light beams.

Alarm devices may be (1) audible signals, such as gongs, bells, buzzers, horns, sirens, or chimes, of tones that are distinctive of other signals used on the premises, or (2) visual signals. Alarms may be located in several parts of the premises, and on the exterior of the building.

Contacts and alarms

1. The simplest type of system may employ one or more manual or automatic contact devices of the normally-open type connected in multiple to one or more alarms. The operation of any contact device will actuate an alarm. Such a system requires no relays, and may be operated from dry cell batteries, a transformer, or on 110 volts, provided devices of the correct voltage are selected. This system is not easily tested or checked.



2. Where a system must be kept under daily supervision and must be tested to make sure of its positive functioning, a relay and control cabinet should be provided. The system may then be divided into several circuits. All manual contact devices may be either of the open or closed circuit type and connected to their respective relays in the control cabinet. The automatic contact devices should be of the closed circuit type to facilitate making daily tests of such circuits.

a. The control cabinet may also include a trouble alarm which will give warning of any derangement in the current supply, or in the circuit wiring.

b. A time clock device may be provided in the control cabinet which will automatically disconnect one or more circuits of contact devices, or one or more circuits of alarm devices at a given time of day or night.

c. Control cabinet systems may be operated from batteries, transformers, power units, and in some types of hold-up equipment, on 115-125 volt d-c or a-c circuits.

d. The amount of current consumed by such systems is dependent upon the number of alarms employed.

Contacts, alarms and annunciator control cabinet.

This type of system is similar to system 2 above except that the control cabinet includes indicating annunciator drops corresponding with the number of separate circuits that are provided between the control cabinet and the contact devices. This system indicates the location at which a contact device has been operated. This feature is useful in a residence or in large plants or stores.

C. Contacts, alarms, annunciator control and leased wire circuit.

This system may incorporate the various features of system A-2 or system B, and may in addition provide relays to operate leased circuits leading to alarms in police stations or patrol agencies.

Burglar Alarm: Furnish and install a (give here descriptive designation of the system, manufacturer's name and catalog number) burglar alarm system. This system shall operate on .... volts.

Conductors—

All conductors shall be No. .... ga., and shall have 600 volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

Wiring method—

All conductors shall be installed in (Name wiring system to be employed). Wiring shall terminate at each outlet for a contact or signal device in an outlet box suitable for the equipment for which the outlet is intended.

Raceway wiring is recommended, excepting that in residences the wiring method may be the same as is employed for other portions of the wiring system.

Equipment—

Specify items of equipment as required for the system to be installed.

For systems A-1, A-2, B or C: (1) Window spring contacts (closed circuit type) (open circuit type), (2) list in order other types and makes of contact devices as selected, using the correct catalog number for each, (3) audible signals, (4) visual signals, (5) plate glass foil, (6) dry cell batteries, storage batteries and charger, power unit, or transformer.

Additional items for systems A-2, B or C: (1) Control cabinet (describe special features), (2) photo-electric cell.

For system B: (1) Control cabinet with visual indicator or annunciator (describe special features and state number of circuits).

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7.19 Electric clock systems: The more commonly used electric clock systems are as follows:

A. Synchronous motor clocks with no central control.

B. Synchronous motor clocks with master resetting control.

C. Master and secondary clock system.

A. Synchronous motor clocks with no central control

This system consists of synchronous motor clocks connected to 110-115 volt a-c service. This is a satisfactory system in localities where interruptions of the light and power service are very infrequent. In case any such interruption does occur, each clock must be reset individually. In order to avoid stoppage of clocks because of the blowing of fuses on the general building circuits, it is recommended that special circuits for clocks be specified, not over 25 clock outlets to be wired on one circuit.

B. Synchronous motor clocks with master resetting control

For this system the clocks may be the same as for System A, in which case a frequency changer is provided so that when an interruption of service has occured, the clocks may be operated at double frequency until they are brought up to the correct time, or each clock may be provided with a dual motor so that the clocks may be speeded up for such time as is necessary to compensate for the interruption. Both methods of regulation may be either manual or automatic. This system is preferable to System A in localities where occasional service interruptions may be expected and where more than six or eight clocks are installed on the same premises. Each clock circuit must be brought back to the central control panel. For dual motor clocks each circuit consists of three wires. Not over 25 clocks should be wired on one circuit. Systems which must be kept in operation during intervals of service interruption can be provided with emergency battery equipment and automatically-controlled motor-generators for temporarily supplying a-c power to the clocks.

C. Master and secondary clock system

In this system a master clock is employed which is designed to keep accurate time within a few seconds per month. The motive power of the secondary clocks consists of an electromagnet which is energized once per minute or oftener by a circuit closing device on the master clock, usually through relays on a control panel. An impulse or series of impulses is sent out by the master clock once per hour which brings all secondary clocks into exact synchronism, in case any are slow or fast.

Time stamps and employees' time recorders are clocks equipped with special mechanical devices. They may be synchronous motor clocks or secondary clocks actuated by a master clock. These devices require considerably more power for their operation than simple time-indicating clocks and this must be taken into account when the operation of the device is controlled by a master clock.

The equipment supplied by one manufacturer requires .024 amp., at 24 volts for each secondary clock, and .10 amp. for each time stamp, and the energy taken by equipment of other makes will not vary a great deal from these figures. It is good practice to design secondary clock circuits for loads not exceeding 1.25 amp. per circuit at 24 volts.

System: Furnish and install a (give here descriptive designation of the system, manufacturer's name and catalog number) clock system including:

a-1. (System A or B) . . . . clocks

a-2. (System C) one master clock, (catalog number) and . . . . secondary clocks

a-3. . . . . time stamps, (catalog number)

a-4. . . . . employees' time recorders, (catalog number)

b-1. (System C) storage battery and charging equipment

b-2. Rectifier unit for power supply

c. (System B or C) control panel (catalog number)

All equipment shall be located as shown on the plans and the entire system shall be installed in conformity with the manufacturer's specifications.

Clocks (Or for System C, secondary clocks)—

Specify the number required of each size and style of case.

Cases may be of wood as desired or of metal with any desired metal finish; round, square or octagonal in shape; flush or surface type.

Dials may be 8 in., 14 in., 16 in. or 18 in., in diameter; of metal or wood, or of glass illuminated from inside the case; with Arabic or Roman numerals.

Clocks shall be mounted at a height of 10 ft. from the floor to the center of the dial, except as otherwise specified and except that the distance from the ceiling to the upper edge of the case shall be not less than 12 in.

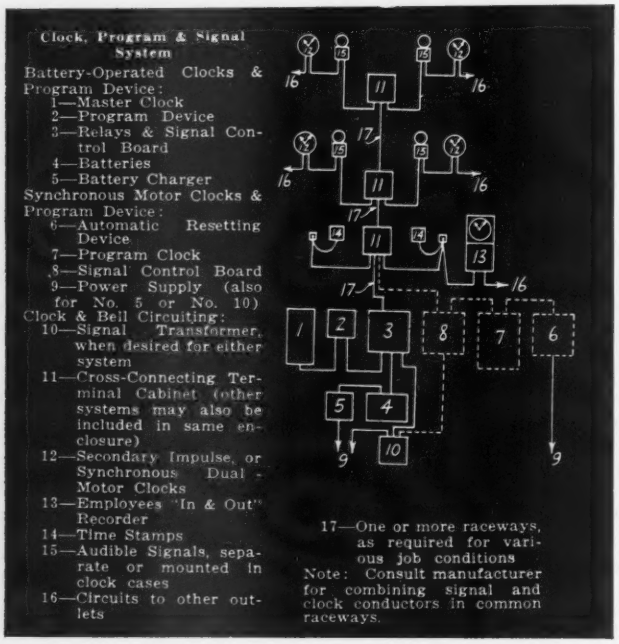
Control panel (Systems B and C)—

Specify manufacturer's name and catalog number.

Power Supply (System C)—

a-1. Furnish and install a (name and catalog number) rectifier power supply unit.

a-2. Furnish and install a storage battery consisting of 12 glass jar cells of . . . . ampere-hour capacity each,



mounted in a wood tray on a suitable stand, a rectifier capable of bringing the battery up from full discharge to full charge in 24 hours, and a charging panel with equipment to automatically cut in the rectifier when the battery voltage drops to 1.8 volts per cell and automatically cut out the rectifier when the battery is fully charged. Storage cells shall be (name and catalog number) and charging panel shall be (name and catalog number).

Wiring—

All clocks shall be wired in multiple. Each circuit shall consist of:

a-1. two conductors (for System A, and for System B except where dual-motor clocks are used).

a-2. three conductors (for System C, and for System B where dual-motor clocks are used).

b. Provide a circuit of suitable capacity from the nearest lighting panelboard to the control panel. (For Systems B or C.)

Conductors—

All conductors shall be No. 14, and shall have 600 volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

Wiring method—

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

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7.20 Program systems: A program system consists of one or more signal devices (bells, buzzers or sirens) and a program instrument which automatically closes a circuit or circuits, causing the signal devices to operate on one or more predetermined schedules.

The program instrument must be driven by a clock mechanism, which may be any one of the three types of clocks described under the heading of Electric Clock Systems. Where clock system C is employed, the program instrument may be incorporated with the master clock. A program instrument may be designed to actuate each of one or more separate circuits (seldom more than four) on a separate schedule. Each schedule, or program, can be predetermined as desired by means of adjustable contacts. The program instrument can, if desired, be so designed that it can be set to omit all signals during any 6 or 12-hour period, and can be designed to omit all signals on one or more days of each week.

A control panel with a relay for each circuit is standard equipment.

Signal devices—

The signal devices may be bells, buzzers, gongs or sirens. Bells and gongs are usually of the vibrating type. The signal devices on each circuit are usually connected in multiple, though in some cases series connections may be used. The operating voltage is commonly about 24 volts for d-c and 24 or 110 volts for a-c operation.

Power supply—

For d-c operation the power supply may be a storage battery with automatic charging equipment, or a rectifier unit. For a-c operation the signal devices may be operated direct from the 115-volt wiring system, or through a signalling transformer.

AUDIBLE SIGNAL DATA

TYPE OF SIGNAL	AC		DC		AC		DC	
	12 Volts	24 Volts	12 Volts	24 Volts	12 Volts	24 Volts	12 Volts	24 Volts
	Amperes				Watts			
Small Buzzers	0.5	0.15	0.5	0.3	6.0	3.6	3.5	3.5
Large Buzzers	0.3	0.15	0.5	0.10	6.0	3.6	4.0	4.0
Small Bells 2½"-4" (Special Wound)	0.6	0.2	0.6	0.15	6.0	6.0	3.5	3.5
Large Bells 2½"-4" (Standard Wound)	0.4	0.2	0.5	0.10	5.0	5.0	3.5	3.5
Large Bells 6"-8"	1.0	0.25	0.35	0.11	8.0	8.0	4.5	4.5
Large Bells 10"-12"	1.0	0.25	0.40	0.12	10.0	10.0	5.0	5.0
Polarized Bells 3"-4"	0.35	0.15	....	....	4.0	4.0	....	....
Polarized Bells 6"-8"	0.35	0.15	....	....	5.5	5.5	....	....
Polarized Bells 10"-12"	0.5	0.33	....	....	6.0	8.0	....	....
Small Buzzers, Solenoid Type	1.2	0.5	....	....	18	12	....	....
Small Bells, Single Stroke	1.5	0.8	....	....	20	20	....	....
Large Bells, Single Stroke 4"	1.0	1.0	0.5	0.5	24	24	12	12
Large Bells, Single Stroke 6"-8"	1.0	1.0	0.5	0.5	24	24	12	12
Large Bells, Single Stroke 10"-12"	1.0	1.0	0.65	0.65	24	24	16	16
Vibrating Horns	1.6	0.8	1.7	0.7	16	22	20	20
Small Chimes	1.0	1.0	0.5	0.5	15	15	12	12
Large Chimes	1.3	1.3	0.5	0.5	23	23	12	12

Pushbutton panel—

Where a multi-program system is used, to secure complete flexibility of control one wire from each signal device may be brought back to a pushbutton panel so arranged that any device can be manually operated individually, and by means of cross-connecting straps any device can be connected to operate on any program.

Specifications—

Furnish and install a complete program system consisting of the equipment specified below and all wiring and devices necessary for the satisfactory operation of the system.

Program instrument—

The program instrument shall be of (manufacturer's name) make, catalog No. ...., and shall be of the

a-1. single-program

a-2. ....-program

type. The program instrument shall be so arranged that it can be set to omit all signals during any period.

b. and to omit all signals during any one or two days of each week.

c-1. The program instrument shall be operated by a (specify here the type of clock to be employed, as synchronous motor clock, dual synchronous motor clock, or secondary clock. If to be a secondary clock, specify the type of master clock.) (See Section 803).

c-2. The program instrument shall be incorporated with the master clock specified in Section ....

Control Panel—

Provide a (manufacturer's name and catalog number) control panel with relays for operation of .... circuits to signal devices.

Pushbutton panel (Optional)—

Provide a (manufacturer's name and catalog number) pushbutton panel equipped with .... pushbuttons for individual operation of the signal devices and with bus-bars and cross-connecting straps so arranged that any signal device can be connected to operate on any one of the .... programs.

Specify for d-c operation a .... volt storage battery with automatic charging equipment, or a rectifier unit to deliver .... volts; for a-c operation, a signaling transformer of suitable wattage and voltage, or direct operation from the 115 volt wiring system.

Specify the number of each size and type of buzzers, bells, gongs and horns and their locations, giving the manufacturer's name and catalog numbers.

Wiring—

Wiring shall be installed in accordance with the program bell wiring diagram. (A complete diagram should be prepared, showing all raceway sizes and the number and size of wires in each run.)

Conductors—

All conductors shall be No. .... ga., and shall have 600 volt insulation of a type suitable to the locations and conditions. They shall be of the make and grade as elsewhere specified.

Wiring Method—

All conductors shall be installed in (Raceway wiring is recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

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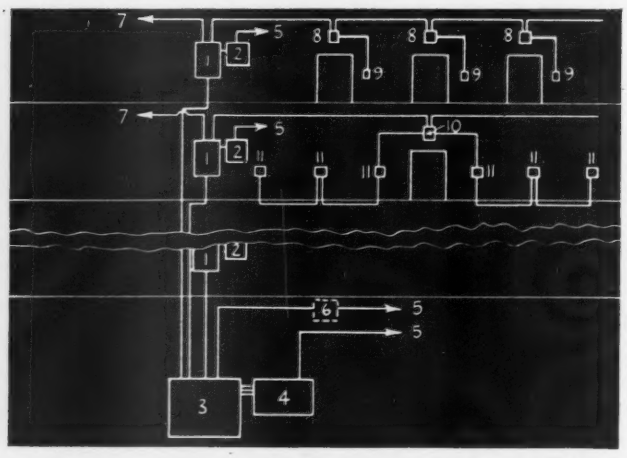
7.21 Nurses' calling system: System types include:

A. Magnetic-drop annunciators

B. Lamp annunciator systems

C. Nurse-patient talking systems.

A. Magnetic-drop annunciator systems: This system is suitable for use in hospitals comprising a small number of rooms. Patients may operate a signalling button or switch to energize a corresponding drop on an annunciator located at the nurses' station. Audible signals may be included at the annunciator, but lamp signals are not recommended to be combined with such systems.



Nurses' Calling System 1—Nurses' station annunciator, 2—Elapsed time recorders (when master recorder is not used), 3—Master annunciator (Supt. office), 4—Master elapsed time recorder (instead of No. 2), 5—Power supply, 6—Signal transformer (for low-tension systems), 7—Power supply at each floor for large systems, instead of No. 5, 8—Corridor signal dome, 9—Patients calling station, 10—Ward entrance corridor signal dome, 11—Patients calling and pilot lamp station for wards

B. Lamp annunciator system: This system is used in hospitals of all sizes. Patients' calling stations are provided for turning on lamp signals and auxiliary audible signals in one or more lamp annunciators. Calling stations may consist of flexible cords and pushbuttons, cord-pull lever switches, wall switches, or wall pushbuttons. Patients' calling stations in wards may include bull's-eye pilot lamps to indicate which of two or more patients in one ward have called for a nurse. Lamp signal domes are provided in the corridors above the entrance to each room or ward. When turned "on" by a patient, the corridor and annunciator lamp signals usually remain "on" until turned off by a nurse at the patient's calling station.

Annunciators are provided at nurses' stations equipped with numbered lamp lenses or luminous cover plates to correspond with the number of calling stations provided in the wing or area served by a particular nurses' station. Additional annunciators may be added in diet kitchens or other areas. A master annunciator may also be included in the supervising nurse's office to indicate all calls.

A master recording device, or separate devices at each nurse's station, may be included to provide an individual chart record of the elapsed time between patients' calls and the nurses' arrival at the patients' calling stations.

Additional signalling facilities may be provided in one or more rooms by which a nurse or patient may operate an auxiliary calling station to indicate an emergency signal. Such emergency signals may be separate lamps of a distinctive color, in corridor domes or in annunciators. These signals may also include auxiliary audible signals of a distinctive tone.

C. Nurse-patient talking system.

This system employs fixed or portable microphones and speakers for patients to establish voice communication with their nurse. The nurses' station equipment consists of a terminal cabinet, an annunciator and a keyboard control unit for switching a patient's conversation to a nurse's microphone and speaker instrument. This system may be operated independently of, or in conjunction with a modification of system B.

Installation.

System A is designed primarily to be operated at low voltages by a signalling transformer. System B is available in 110 volt and low voltage types. System C may be designed for combinations of 110 volt and low voltage.

Nurses call

Furnish and install a (trade name or number) nurses' calling system as indicated on wiring plans, as manufactured by (name of manufacturer) all of which shall be installed in accordance with the manufacturer's specifications. This system shall operate on .... volts.

Conductors—

All conductors shall be No. ..... ga., and shall have 600 volt insulation of a type suitable to the locations and the conditions. They shall be of the make and grade as elsewhere specified.

Wiring methods—

All conductors shall be installed in (Raceway wiring is

recommended. Name wiring system to be employed). Wiring shall terminate at each outlet in an outlet box suitable for the equipment for which the outlet is intended.

Equipment—

Specify items of equipment as required for the system to be installed.

(1) Patient's room calling stations; (2) Patient's ward calling stations; (3) Patient's emergency calling stations; (4) Patient's microphone and speaker stations; (5) Nurses' station sound amplification equipment; (6) Nurses station, diet kitchen, or master annunciators; (7) Elapsed time recorders; (8) Corridor domes; (9) Signal lamps; (10) Audible signals; (11) Transformers; (12) Terminal cabinets; (13) Special cables; and (14) Special outlet boxes.

8.1 Lighting

Lighting specifications may be drawn around (a) the lighting effect to be accomplished, (b) the kind of lighting components and fixtures to be used, and (c) the specific units to be installed.

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8.11 Furnish and install lighting fixtures, lighting equipment and lamps for all lighting outlets in the project as shown on plans and listed in the "Schedule of Fixtures," including the connection of the fixtures and equipment to the electric wiring of the building.

Special lighting fixtures and lighting equipment shall be as shown on the drawings.

SCHEDULE OF FIXTURES

Quantity Fixtures Required	Fixture Type	Quantity and Lamp Wattage Per Fixture	Glass-ware or Re-flector Type	Fixture Length	Location
4	X	1–50	X1	C	Aud.
24	C	4–40F	——	48 in.	Aud.
5	D	4–40F	——	C	Aud.
8	F	1–100	F1	C	Entry
2	G	1–50	G2	12 in.	Door
18	N	1–50	N1	24 in.	Base

All lighting fixtures and lighting equipment shall be furnished in strict compliance with the drawings, fixture details and specifications.

All materials and accessories, whether specifically described or not, shall be of the best grade of commercial manufacture and all workmanship shall be first class in every respect.

Models, patterns or photographs of special fixtures shall be submitted for approval when required. Models or patterns shall be corrected and made satisfactory before any work is done on the lighting fixtures.

Fixture parts shall be made of aluminum, brass, bronze, copper, steel or other metal as required and shall be of composition and temper required by the manufacturing processes involved and suitable for the duty or function of the particular fixture part.

In cases where aluminum members are to be fastened to steel or other dissimilar metal parts, the aluminum shall be separated from such parts by a heavy coat of aluminum or bituminous paint to the contact surfaces of the metals and allowed to thoroughly dry before assembly, or by strips of insulation fiber, so placed as to effectively break the contact between them.

Aluminum sheet of less than No. 10 gauge when placed in contact with brick, plastic, gypsum, concrete or similar masonry construction, the aluminum shall be back-painted before installation with the aluminum or bituminous paint.

All burrs, fins and sharp edges must be removed from fixture parts before they are assembled. Canopies, holders, etc., shall be spun or drawn in one piece unless otherwise shown or noted. All fixtures with the conventional canopy shall be provided with suitable ⅜ inch hickey and nipple of proper length with running thread to permit correct fitting and adjustment of canopy with both fixture and ceiling.

The finish of fixtures shall be the manufacturer's standard finish except as otherwise noted on the fixture schedule.

Medium screw base lampholders or sockets shall be used for incandescent lamps of 200 watts and smaller. Mogul screw base lampholders or sockets shall be used for incandescent lamps of 300 watts and larger.

Sockets and receptacles for fixtures using enclosing glassware shall be of porcelain or non-inflammable moulded compound.

Fixture wire shall be in strict compliance with the latest requirements of the National Board of Fire Underwriters. The carrying capacity of the wire shall meet the latest requirements of the National Electrical Code. No fixture wiring shall be smaller than No. 16 gauge. Wiring shall be protected with tape or tubing at all points where abrasion is liable to occur. All wiring shall be concealed within fixture construction, except where chain suspension is required.

The fixture wiring of chain suspended fixtures shall match the fixture finish. The single wires shall be interlaced in the alternate links of chain. One conductor shall have a continuous identifying marker, readily distinguishing it from the other conductor, the marked conductor to be connected to the screw shell side of the socket or lamp receptacle. Chain suspended lighting fixture shall be wired with flexible conductors of sufficient length that the weight of the fixture will not put tension on the conductors and there shall be sufficient ends allowed for making connections to the wiring of the building.

No splice or tap shall be located within an arm, stem or chain. Wiring shall be continuous from splice in outlet box on the building wiring system to lampholder or to ballast and from ballast to lampholders.

Wiring for drop cord fixtures and pendent switches shall be No. 16 (unless otherwise specified) type "SJ" all-rubber portable cord.

All joints in fixture wiring shall be soldered and well insulated with rubber and friction tape. Approved solderless connectors may be used in making connections in the wiring within the fixtures or in connecting the fixture wiring to the wiring of the building.

The length of an indirect lighting fixture or trough as given in the schedule means the length from the ceiling to the top edge of the reflector or trough. The length of other types of lighting fixtures means the length from the ceiling to the bottom or the lowest part of the fixture body, reflector or glassware in its hanging position.

The dimensions of holders for reflectors or globes shall comply with the dimensions and tolerances required to suit standard fitters, i.e., those commercially referred to by glassware manufacturers as 2¼, 3¼, 4, 6 and 8 inch. unless definitely specified to be otherwise.

Silver mirrored glass reflectors shall be of high quality glass, properly annealed, virtually free from color, bubbles and scratches. The reflecting surface shall be pure silver. The reflecting surface shall be protected by a suitable backing which will safeguard it from ordinary atmospheric conditions under temperatures which will prevail when operated with lamps of sizes for which the reflectors are designed. Reflectors shall not mottle, peel, check or tarnish under normal service conditions.

Porcelain enameled steel reflectors specified or indicated to be "Standard Dome," "Deep Bowl", "Symmetrical Angle", etc., shall be of substantially the same contours and dimensions as those commercially known by those designations and as produced under the requirements of the "RLM Standards Institute".

Canopy pull switches: Switches of this type when required, shall be of the single pole, pull type, within canopy or fixture body leaving the switch lever only protruding on exterior of the fixture or shall be inserted in fixture chain by means of a suitable adapter which shall replace one link of chain, the particular mounting to be as required by the contract drawings or specification. The rating of the switches, when in connection with fixtures in which incandescent lamps of 200 watts and larger are to be operated, shall not be less than 10 amperes, T rating, 125 volts 5 amperes, 250 volts, and for lamps less than 200 watts shall be not less than 6 amperes, 125 volts 3 amperes, 250 volts. A short length of bead chain shall extend from the switch lever with a length of heavy linen cord securely attached thereto and extended from the short length of bead chain, and terminated 6 feet 6 inches above floor with a suitable bell or tassel.

Pendant switches: Switches of this type when required shall be of the brass shell, enclosed push-through button type of switch rated not less than 6 amperes 125 volts, 3 amperes, 250 volts. The switch shall have pendant cap with bushed cord hole of size to admit the required pendant cord without damaging or removing the outer jacket. The finish of the brass shell shall be finished to match the lighting fixture specified finish.

Wireways or wiring channels shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear shall be rounded or bushed in the most suitable manner. Insulated bushings shall be installed at points where flexible wiring enters raceway.

When suspended on three points, glassware shall hang plumb. Surface brightness shall not exceed 3 candle power per square inch at any point when equipped with a 200 watt general service lamp properly located. Fitter size shall be 6 inches.

Fluorescent auxiliary equipment: "Ballasts" and "Starter Switches" in connection with fluorescent lighting equipment shall be of the best quality. Unless otherwise required by special fixtures, ballasts having standard cross section dimensions shall be provided. Auxiliary equipment shall be firmly and securely fastened in place.

Fluorescent lampholders shall be of such design that lamps may be inserted or removed easily, but shall hold lamps firmly in place when in use.

High voltage fluorescent: When shown on plans and indicated on the fixture schedule furnish and install the high voltage (cold cathode) fluorescent lighting fixtures and components required.

Fixtures shall be of an approved type designed to meet the latest requirements of the National Electrical Code. Where standard length replaceable tubes are installed the sockets shall be so designed that tubes cannot be removed without opening the primary circuit.

Where tubing is formed and fitted to structural contours, shapes or lengths shall be installed according to the prevailing practice by specially skilled mechanics.

Transformers shall be designed to provide the secondary voltage and milliampere rating necessary for the tube footage and tube diameter installed. Housing shall be of heavy duty type steel. Primary circuit shall be disconnectable by an interlocking safety device, and secondary circuit shall be grounded to the case.

Installation of Lighting Fixtures: All lighting fixtures must be actually installed by experienced mechanics.

Upon completion of the installation of the lighting fixtures and lighting equipment, they must be in first class operating order and in perfect condition as to finish, etc. At time of final inspection all fixtures and equipment must be complete with the required glassware or reflectors which must be clean and free from defects. Any reflectors or glassware broken prior to the time of final inspection must be replaced.

Tests: After lighting fixtures and lighting equipment are connected to the wiring system of the building or project, the wiring system and the fixtures or equipment must be test free from short circuits and grounds and must show an insulation resistance between conductors and between conductors and ground based on minimum load not less than the requirements of the latest edition of the National Electrical Code.

In the event the contractor does not within a reasonable time remedy all defects and make all changes demanded to satisfactorily complete the installation, the right is reserved to have the defects remedied or changes made and to charge the cost to account of the contractor.

Coordination of work: The furnishing and installation of the lighting fixtures and lighting equipment must be executed in such a manner as to insure its completion coincident with the completion of the construction and mechanical equipment unless otherwise required by the contract specifications.

8.12 Stage Lighting and Control Equipment: The following data and specifications are intended to apply only to the stages found in school auditoriums, lodge halls and other assembly halls of small or medium size. Much more elaborate equipment is required in commercial theatres and large auditoriums.

Permanent lighting equipment consists of footlights and borderlights. Both footlights and borderlights are arranged to produce illumination in either white, red or blue or any desired combination of these colors, the total number of lamps being equally divided between the three colors. The better class of equipment is provided with an individual reflector for each lamp, the reflector being fitted with a lens of clear or colored glass termed a "roundel." As compared with the open trough construction and dip-colored lamps formerly used, the individual reflector type is far more efficient and has a much lower maintenance cost. The length of footlights and borderlights should be about 5 ft. less than the width of the proscenium opening.

Footlights: Unless otherwise specified, a footlight is understood to be of the type that is permanently fixed in position. Disappearing footlights are desirable in school and lodge hall auditoriums and other halls where the stage is often used as a lecture platform. When not in use, a hinged cover folds down to cover the opening in the floor and at the same time the footlights automatically lowered and the supply circuits are opened by a switch. Disappearing footlights are regularly made in sections 5 ft. long.

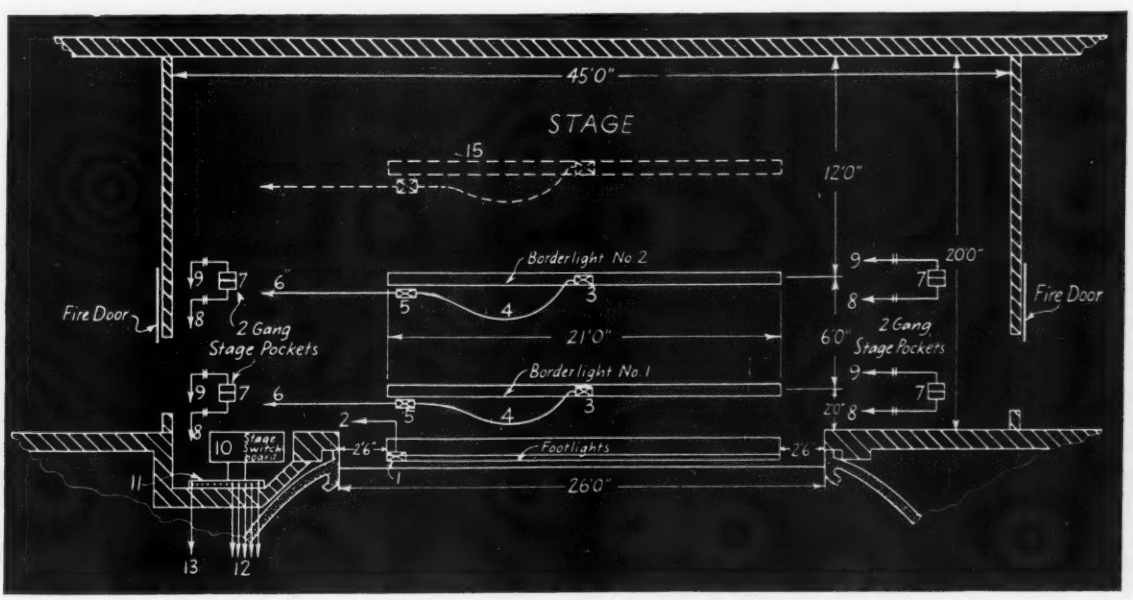
Lamps are spaced approximately 6 in. on centers. A single row of 100 watt lamps is recommended as a minimum. For better lighting, one row of 150 watt lamps may be used, or two rows of 100 watt lamps.

Borderlights: The first borderlights should be located about 2 ft. from the proscenium arch, or as near this position as possible without interfering with other equipment. If two or more borders are installed, the spacing measured on a line from front to back of stage should be about 6 ft. on centers. One borderlight is usually sufficient for a stage 14 ft. deep or less. Two should be provided for depths up to 20 ft., three up to 26 ft. and four up to 32 ft. When the full depth of a stage is to be utilized for scenery, one additional border may be needed in each of the above cases. It is recommended that 100 watt lamps be used as a minimum, with 150 watt or 200 watt lamps for higher lighting intensities. The spacing should be approximately 6 in. on centers for 100 or 150 watt lamps and 8 in. for 200 watts. For installations including two or more borders, one or two independently controlled lamps for use as working lights should be included in at least one of the borders.

All borderlights should be so hung that the angle of light distribution (downward and toward the back of the stage) can be adjusted to secure the best results. Except for the smallest stages, the height of each border from the floor should be adjustable within reasonable limits. Where the height will be such that the borders cannot be reached by means of a stepladder for adjustment, cleaning and replacing lamps, each border should be hung on two or more flexible steel cables passing over sheaves and down to a counterweight at the wall on one side of the stage. Except where a borderlight is permanently secured in position, the necessary number of circuits should be brought to the border in a borderlight cable from a junction box on the stage ceiling. (For a fully-equipped stage the junction boxes must be placed on the gridiron.)

Stage pockets: For the connection of portable lighting equipment, a stage floor pocket should be installed at each side of the stage on a line with each border and 6 ft. from the line of the proscenium opening, measuring away from the center line of the stage. Each pocket should be equipped with two receptacles, one to be wired from the control board on a separate circuit of No. 12 wire and the other pocket receptacle on a separate circuit of No. 6 wire.

In some cases where the stage is small it may be satisfactory to provide, in place of floor pockets, one or more convenient outlets on each side wall of the stage.



Typical stage lighting for a small auditorium

These outlets should be provided with duplex receptacles of the split circuit type and each outlet should be wired on a separate three-wire circuit from the control board.

Control: Stage lighting control equipment must be dead front and may be in the form of a panelboard or a switchboard. For small stages the switches on the control board usually control the lighting circuits directly. For a large and well equipped stage the control switches are commonly of the remote control type operated from a pilot board on the stage.

Where the stage is small and the lighting equipment is very simple, a standard lighting panelboard with a switch or circuit breaker for each branch circuit may be satisfactory. If three colors are used, the minimum requirements would be three circuits for the footlights, three circuits for each borderlight and two circuits for each stage floor pocket.

Dimmers: A set of dimmers should be provided in every case where the stage will at times be used for theatrical entertainments. One dimmer unit, operating a separately controlled group of lights would require 12 dimmer units for the footlights and borderlights. The dimmers may also be provided with interlocking equipment and master levers so that all lights of any one color can be dimmed or brightened simultaneously, and various other combinations can be made. Dimmers can also be motor operated and remotely controlled.

Stage Lighting

Furnish and install stage lighting equipment, stage floor pockets and control board as hereinafter specified complete with all wiring and connections, all to be located as shown on the plans.

Footlights

a-1. Provide a footlight .... ft. long

a-2. Provide a disappearing footlight made up of .... 5-ft. sections equipped with lampholders and individual reflectors in (one row) (two rows) for a total of .... watt lamps wired so that lamps are equally divided between three colors. Reflectors shall be equipped with glass roundels, one-third to be clear glass, one-third red and one-third blue. Footlights shall be (manufacturer's name and catalog number).

Borderlights

Provide .... borderlights (manufacturer's name and catalog number) each to be .... ft. long and to be equipped with lampholders and individual reflectors for ...., ... watt lamps wired so that lamps are equally divided between three colors. Reflectors shall be equipped with glass roundels, one-third to be clear glass, one-third red and one-third blue. Borderlights shall be hung on steel chains so that the angle of light throw can be adjusted and

a-1. suspended from the stage ceiling so that their height can be adjusted through a range of three feet.

a-2. suspended by means of flexible steel cables passing over sheaves and down to counterweights so arranged that the borders can be lowered to within 6 ft. from the stage floor. A ½-in. hand rope shall be provided for raising and lowering each counterweight. Connections shall be made to each borderlight through a standard borderlight cable containing the necessary number of No. 12 stranded conductors.

Stage Floor Pockets

Install flush in stage floor .... stage floor pockets (manufacturer's name and catalog number), each to have one arc receptacle wired from the stage control board on a separate circuit of two No. 6 wires, and one incandescent receptacle wired on a separate circuit of two No. 12 wires. Furnish .... arc plugs and .... incandescent plugs to fit receptacles.

Control Board

All stage and auditorium lighting circuits, except circuits for emergency and exit lighting, shall be controlled at the stage control board.

a-1. Provide a (manufacturer's name and catalog number) panelboard and cabinet with (plug fuses and switches) (circuit-breakers) for the control of .... branch circuits.

a-2. Provide a dead-front stage switchboard with steel plates at ends and top extending to proscenium wall to form a complete enclosure. A door shall be provided at one end for access to the space in the rear of the board. Provide the following control switches and all necessary fuses. All switches shall be of ample rating for the load to be controlled and the rating shall in no case be less than 30 amp.

Control Switches

This list is typical and should be modified as necessary to meet the actual conditions.

1—Stage Master controlling all stage lighting except pockets

1—White Master controlling all white lights

1—Red Master controlling all red lights

1—Blue Master controlling all blue lights

4—White	Foots Border No. 1 Border No. 2 Border No. 3
4—Red	Foots Border No. 1 Border No. 2 Border No. 3
4—Blue	Foots Border No. 1 Border No. 2 Border No. 3

12 for Stage Pockets

1—House Master controlling all auditorium lighting (except emergency and exit lights).

—controlling auditorium lighting. (Specify here the switches needed to provide the desired divided control of the auditorium lighting.)

Dimmers

a-1. Install immediately above the stage control panelboard a bank of dimmers in a metal enclosure with operating levers projecting through the front. One or more sides of the enclosure may be of heavy steel mesh. The enclosure shall be so constructed as to give access to the dimmer plates for servicing or removal and shall be suitably ventilated. Dimmers shall be suitable for continuous duty at any step and shall be (manufacturer's name and type number).

Provide the following dimmer units:

List here the circuits to be provided with dimmers. This arrangement will not be satisfactory if any group of lights to be individually dimmed, such as the white footlights, is controlled by two or more circuit switches.

a-2. Provide as a part of the stage switchboard a bank of dimmers mounted in the switchboard enclosure with operating levers projecting through the face of the board. Dimmers shall be (manufacturer's name and type number). Provide the following dimmer units:

List here the groups of lights to be provided with dimmers; the common requirements is one dimmer unit for each color in each borderlight and one for each color in the footlights. One or more pocket circuits may also be provided with dimmers. Give details of remote controlled dimmers required and the locations of control points. If interlocking equipment with master levers is required, a manufacturer of such equipment should be consulted before the specifications are written.

• • •

8.21 Motors: All motors will be (specify single phase, three phase, etc. and voltage) except that motors smaller than 1/4 hp. will be single phase, ... volt and shall be of types and speeds as specified in the motor schedule.

Where motors are to be furnished under this contract, each motor shall conform with the NEMA standards for motors of the type and speed specified.

If more than a bare motor is to be furnished, detail specifications should be given for each motor covering the type of base, such as sliding rails, automatic tension adjusting base, etc., and the type of mechanical power transmission equipment, such as belt and pulleys, chain drive, gear drive, coupling for direct connection, etc.

• • •

8.22 Motor control: This includes only the more common types of general purpose motor control apparatus for alternating current motors and is not intended to cover controllers for multi-speed motors, synchronous motors, elevators or the many special power applications found in industrial plant practice. For all such special applications, detailed specifications for each item of equipment should be obtained from the manufacturers.

Each motor rated at 1/6 hp. or over shall be equipped with a starter or controller which will provide running overcurrent protection for the motor. Overcurrent devices shall open all leads to the motor except that for two-phase motors, only three leads are required to be opened. All starters and controllers shall be enclosed in substantial metal enclosures and shall conform with the NEMA Industrial Control Standards.

Type A starters shall be manually operable by means of a lever, knob or pushbuttons, for full-voltage starting.

Type B starters shall be magnetically operable, for full voltage starting, and shall be provided with undervoltage protection. Provision shall be made for remote control by means of wires leading to other control stations.

Type C starters shall be of the manually operable autotransformer type, for reduced voltage starting. Each starter shall be provided with undervoltage protection and shall have a stop pushbutton in the cover.

Type D starters shall be of the magnetically operated autotransformer type for reduced voltage starting. Each starter shall be provided with undervoltage protection and shall be arranged for remote control.

Type E starters are for use with wound-rotor motors for starting duty only. Each controller shall consist of an assembly of a magnetically-operated primary switch and a resistor switch with suitable resistors. The primary switch shall provide running over-current protection and undervoltage protection for the motor. The resistor switch shall be electrically interlocked with the primary switch so that the primary switch cannot be closed unless all resistors are connected. Resistor switches shall be of the dial type for motors of 10 hp. rating or less and shall be of the drum type for larger motors.

Type F controllers are for use with wound-rotor motors for speed regulating duty and shall provide for 50 percent speed reduction and continuous operation at any speed from maximum to minimum. Type F controllers shall in all other respects conform with the specifications for Type E starters.

All control equipment shall be mounted with operating levers or pushbuttons at a height of approximately four feet above the floor. All necessary expansion bolts, brackets and other structural steel parts shall be furnished to provide secure mounting on walls, columns or machine frames as indicated on the plans or, where so indicated, equipment shall be mounted on frames.

Disconnecting means: Where required by the National Electrical Code, a manually operable disconnecting means shall be provided for each motor or for each group of motors driving the several parts of a single machine. Switches and circuit breakers used for this purpose shall be provided with metal enclosures and shall be externally operable and manually operable. The disconnecting means for a permanently installed motor shall be mounted immediately adjacent to, or in the same enclosure with, the motor starter or controller and, if a switch, shall be non-fusible, except that a fusible switch at a distribution center may serve as the disconnecting means if within sight of the motor or if arranged to be locked in the "off" position.

• • •

8.22 Motors and control by others: Motors and motor control apparatus shall be furnished and installed complete with all wiring as listed in accordance with other sections of these specifications, control for these motors apparatus will be furnished by others, but shall be installed under this contract.

All wiring and disconnecting means, where required, shall be furnished and installed for motors listed in accordance with other sections of these specifications. Motors and control apparatus will be furnished by others.

• • •

8.23 Electronic controls: For apparatus shown on plans to be electronically controlled, furnish and install the controls listed complete with all wiring in operating conditions. (List control elements required, for example, light source, photocell pickup, amplifier, relay, controller, etc.) Furnish two copies of wiring diagrams and maintenance instructions. Provide one complete set of replacement tubes.

9.1 DATA TABLES

VOLTAGE DROP TABLE

1. To find the size of wire required for a given voltage drop stated in percentage of the line voltage:

Find the "ampere-feet" by multiplying the current in amperes by the length of one wire in feet (not the total length of wire in the circuit).

Find the line voltage in the upper left corner; follow this horizontal line to the right to the given percent drop, follow this column down to the number of ampere-feet nearest to the actual number calculated. Follow this horizontal line to the left. The required size is the size found on this line.

2. To find the percent voltage drop which will be produced by a given size of wire:

Find the ampere-feet as above.

Starting with the given size of wire follow this horizontal line to the right to the number of ampere-feet nearest to the actual number calculated. Follow this column up to the percent drop on the line corresponding to the line voltage.

Volts	PERCENT DROP										
550	4	2	1.6	1.4	1.2	1.0	0.8	0.6	0.4	.....	.....
440	5	2.5	2	1.75	1.5	1.25	1	0.75	0.5	.....	.....
220	10	5	4	3.5	3	2.5	2	1.5	1	0.75	0.5
110	20	10	8	7	6	5	4	3	2	1.5	1

SIZE OF WIRE	AMPERES — FEET (AMPS × SINGLE DISTANCE IN FEET)										
14	.....	.....	1,670	1,460	1,250	1.050	840	630	420	310	210
12	.....	.....	2,660	2,320	1,990	1,660	1,330	1,000	670	500	330
10	10,600	5,300	4,200	3,700	3,170	2,650	2,120	1,590	1,060	790	530
8	16,800	8,400	6,700	5,900	5,000	4,200	3,400	2,520	1,680	1,260	840
6	26,700	13,400	10,700	9,400	8,000	6,700	5,300	4,000	2,670	2,010	1,340
5	33,700	16,900	13,500	11,800	10,100	8,400	6,700	5,100	3,370	2,530	1,690
4	42,500	21,300	17,000	14,900	12,800	10,600	8,500	6,400	4,300	3,200	2,130
3	53,600	26,800	21,400	18,800	16,100	13,400	10,700	8,000	5,400	4,000	2,680
2	67,600	33,800	27,000	23,700	20,300	16,900	13,500	10,100	6,800	5,100	3,400
1	85,200	42,600	34,100	29,800	25,600	21,300	17,000	12,800	8,500	6,400	4,300
0	107,500	53,800	43,100	37,600	32,300	26,900	21,500	16,100	10,800	8,100	5,400
00	135,500	67,800	54,200	47,400	40,700	33,900	27,100	20,300	13,600	10,200	6,800
000	170,900	85,500	68,400	59,800	51,300	42,700	34,200	25,600	17,100	12,800	8,500
0000	215,500	107,800	86,200	75,400	64,700	53,900	43,100	32,300	21,600	16,200	10,800
250,000 c.m.	254,600	127,300	101,900	89,100	76,400	63,700	50,900	38,200	25,500	19,100	12,700
300,000 c.m.	305,600	152,800	122,200	106,900	91,700	76,400	61,100	45,800	30,600	22,900	15,300
350,000 c.m.	356,500	178,200	142,600	124,800	106,900	89,100	71,300	53,500	35,600	26,700	17,800
400,000 c.m.	407,400	203,700	163,000	142,600	122,200	101,900	81,500	61,100	40,700	30,600	20,400
450,000 c.m.	458,300	229,200	183,300	160,400	137,500	114,600	91,700	68,700	45,800	34,400	22,900
500,000 c.m.	509,300	254,600	203,700	178,200	152,800	127,300	101,900	76,400	50,900	38,200	25,500

CONVERSION FORMULAS

To Find the Value	When Value Below is Known	SYSTEM			
		Direct Current	Single-Phase	Two-Phase Four Wire	Three-Phase
		FORMULAE			
Amperes (I)	Horsepower (hp)	$I = \frac{746\ hp}{E \times eff}$	$I = \frac{746\ hp}{E \times eff \times pf}$	$I = \frac{746\ hp}{2 \times E \times eff \times pf}$	$I = \frac{746\ hp}{1.73 \times E \times eff \times pf}$
Amperes (I)	Kilowatts (kw)	$I = \frac{1000\ kw}{E}$	$= \frac{1000\ kw}{E \times pf}$	$I = \frac{1000\ kw}{2 \times E \times pf}$	$I = \frac{1000\ kw}{1.73 \times E \times pf}$
Amperes (I)	Kilovolt-Amperes (kva)		$I = \frac{1000\ kva}{E}$	$I = \frac{1000\ kva}{2\ E}$	$I = \frac{1000\ kva}{1.73\ E}$
Kilowatts (kw) Input		$kw = \frac{I \times E}{1000}$	$kw = \frac{I \times E \times pf}{1000}$	$kw = \frac{I \times E \times 2 \times pf}{1000}$	$kw = \frac{I \times E \times 1.73 \times pf}{1000}$
Kilovolt-Amperes (kva)			$kva = \frac{I \times E}{1000}$	$kva = \frac{I \times E \times 2}{1000}$	$kva = \frac{I \times E \times 1.73}{1000}$
Horsepower (hp) Output		$hp = \frac{I \times E \times eff}{746}$	$hp = \frac{I \times E \times eff \times pf}{746}$	$hp = \frac{I \times E \times 2 \times eff \times pf}{746}$	$hp = \frac{I \times E \times 1.73 \times eff \times pf}{746}$

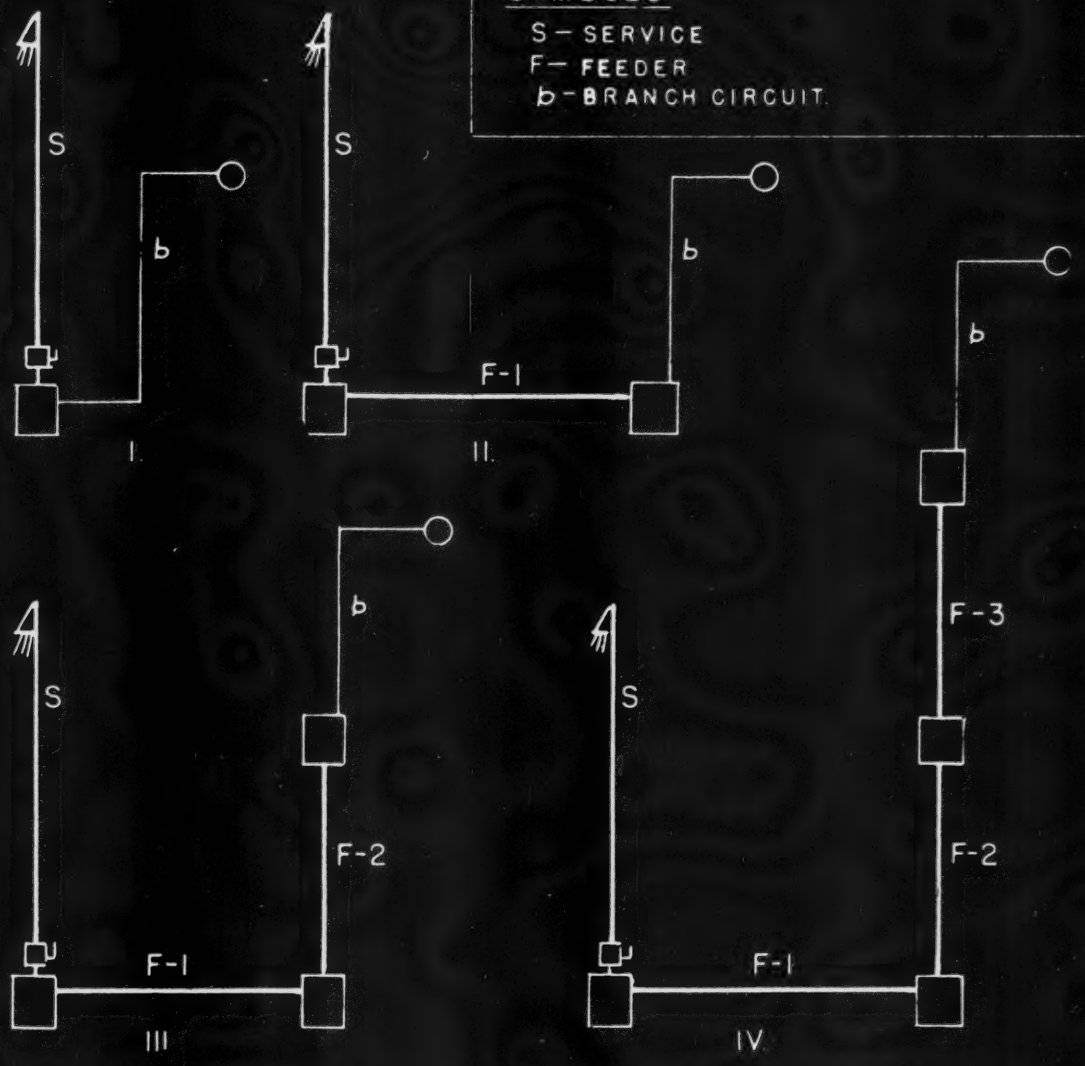
I = Amperes.
E = Volts.
eff = Efficiency in decimals.
pf = Power Factor in decimals.

kw = Kilowatts Input.
kva = Kilovolt-Amperes Input.
hp = Horsepower Output.

For two-phase, three wire, balanced circuits the amperes in common conductor = 1.41 × that in either of the other two.

RECOMMENDATIONS FOR VOLTAGE DROP ALLOWANCES FOR 120/240 VOLT LIGHTING DISTRIBUTION & BRANCH CTS.

SYMBOLS—
S — SERVICE
F — FEEDER
b — BRANCH CIRCUIT



EXAMPLE	ALLOWANCES FOR VOLTAGE DROP											
	S SERVICE 3W 120/240V		F-1 FEEDER SECT 1 3W 120/240V		F-2 FEEDER SECT 2 3W 120/240V		F-3 FEEDER SECT 3 3W 120/240V		b BRANCH CIRCUIT 120 V.		TOTAL DROP-SERV. TO CUT-120 V. 2 W. CIRCUIT	
	% OF 240V.	VOLTS	% OF 240V.	VOLTS	% OF 240V	VOLTS	% OF 240V.	VOLTS	% OF 120V	VOLTS	% OF 120V	VOLTS
I.	2.	4.8	—	—	—	—	—	—	1.	1.2	3	3.6
II.	1.	2.4	1	2.4	—	—	—	—	1.	1.2	3	3.6
III.	0.75	1.8	0.75	1.8	0.5	1.2	—	—	1.	1.2	3	3.6
IV.	0.5	1.2	0.5	1.2	0.5	1.2	0.5	1.2	1.	1.2	3	3.6

By allocating voltage drop over the several parts of the system, individual feeders can be more accurately figured. The chart and table above develop allowances for voltage drop over four distribution systems; simple branch circuit, one feeder and branch circuit and the relatively rare three feeders and branch circuit system. The table shows the distribution of voltage drop in volts and percentage of line voltage in each part.

POWER LOAD DATA

Appliance, Device or Machine	Domestic		Commercial—Industrial	
	Watts	Horsepower	Watts	Horsepower
	From To	From To	From To	From To
LIGHTING EQUIPMENT				
Airport Floods	240–3000		240–3000	
Aisle and Seat Floods	25–60		25–60	
Blue Printing			3–10 Kw.	
Borderlights, Prof. Stage, per ft.			200–2000	
Borderlights, Schools, per ft.			100–500	
Cove, Strips, per ft.	40–200		75–500	
Exit Signs			40–150	
Floodlights, Outdoor	60–500		200–1500	
Floodlights, Window			100–1000	
Fluorescent lamps, per ft.	10–25		10–25	
Footlights, Prof. Stage, per ft.			100–1000	
Footlights, Schools, per ft.			100–300	
Infrared lamps	100–300		250–1000	
Luminaries(Commercial Lighting Fixtures)			200–1500	
Luminous Tubing (Cold Cathode) per ft.			8–12	
Photostat Machines			1–5 Kw.	
Projectors, Amateur Movie	500–750			
Projectors, Amateur Movie and Sound	650–1250			
Projectors, Prof. Movie—(34-V)			1500–3500	1/4–1
Projectors, Visual Lecturing			400–1000	
Reflectors, Show Case, per ft.			30–150	
Reflectors, Show Window, per ft.			100–750	
Spotlights Ball Room	100–500		100–2000	
Spotlights Projection Booth			2750–3300	
Spotlights Stage or Balcony Rail			200–1500	
Spotlights Show Windows			100–1000	
Spotlights Statuary (Residence)	25–300			
Vapor, Mercury, High Intens			250–3000	
Vapor, Sodium			–180	
ELECTRICALLY HEATED EQUIPMENT				
Casseroles	100–425			
Cookers, Food	125–1000			
Dishes, Chafing	160–660			
Driers, Clothes	350–5000	1/4	350–5000	1/2
Driers, Hair	200–550		300–550	
Fireplaces, Artificial	1–2 Kw.		1–2 Kw.	
Friers, Deep Fat			1–2 Kw.	
Heaters, Air	.4–9 Kw.		.4–9 Kw.	
Heaters, Aquarium	50–100			
Heaters, Chick Brooder	1–5 Kw.			
Heaters, Chick Hatchery	1–20 Kw.			
Heaters, Curling Iron			450–750	
Heaters, Immersion Type	150–1000		200–2500	
Heaters, Organ Chamber	1–3 Kw.		2–10 Kw.	
Heaters, Permanent Wave Mach			2–4 Kw.	
Heaters, Soil per 60-ft. & 120-ft. Lengths	400–800			
Heaters, Space Elements			1–3 Kw.	
Heaters, Tank Type Water	1–5 Kw.		1–5 Kw.	
Humidifiers, Portable Room		1/100–1/20		
Ironers, Clothes	1200–3300	1/20–1/4		
Irons, Curling & Marcelling	12–40		50–250	
Irons, Flat	200–1000		500–2500	
Irons, Soldering	60–500		200–400	
Irons, Waffle	300–1320		1–3 Kw.	
Lamps Health and Sun	30–1500		250–1500	

Appliance, Device or Machine	Domestic		Commercial—Industrial	
	Watts	Horsepower	Watts	Horsepower
	From To	From To	From To	From To
Extractors Steam Laundry				5–20
Fans Bracket & Desk	30–100		30–100	
Fans Ceiling	80–125		80–125	
Fans Pedestal	125–300		125–300	
Fans Ventilating 10-in.	35–45		35–45	
Fans Ventilating 12-24 in.		1/40–1/4		1/40–1/4
Fans Ventilating 30-in. & up				3/8–3
Flasher, Sign Switch Drive				1/20–1/4
Freezing Food	3–5 Kw.		3–20 Kw.	
Freezers, Ice Cream		1/20–1/4		
Grinders, Coffee (Stores)				1/6–3/4
Grinders, Meat		1/20–1/4		1/4–1
Grinders, Refuse		–1/4		
Hoists, Ash & Cinder				1–5
Hoists, Tramrail 1-ton				1½–3
Hoists, Tramrail 5-ton				6–10
Hoists, Warehouse Loading				1–3
Lathes, Home Shop		1/8–1/2		
Machines (Floor) Sanding		1/7–1/2		1–3
Machines (Floor) Terrazzo		1/7–1/2		1–5
Machines (Floor) Waxing		1/7–1/2		1/4–1
Machines Sewing		1/50–1/20		1/4–2
Machines Office, Adding				1/20–1/10
Machines Office, Addressing				1/8–1/3
Machines Office, Billing				1/10–1/2
Machines Office, Bookkeeping				1/10–1/2
Machines Office, Computing				1/10–1/4
Machines Office, Dictation				–1/30
Machines Office, Record Shaving				–1/20
Machines Office, Sealing & Stamping				1/10–1/6
Machines Office, Typewriters				1/30–1/10
Mangles, Steam Laundry				7½–20
Mixers, Beverage	30–91		30–100	
Mixers, Dough		1/10–1/4		5–20
Mixers, Food		1/10–1/4		1/6–2
Mowers, Lawn		1/3–1/2		1/3–1
Musicial Instruments, Phonograph		1/20–1/8		1/20–1/4
Musicial Instruments, Piano		1/8–1/4		
Pumps Boiler Feed				1–5
Pumps Brine				2–20
Pumps Drinking Water Circ.				1/2–5
Pumps, Fire Protection				20–150
Pumps, Fuel		1/8–1		1/4–3
Pumps, Household Water		1/6–1		
Pumps, Milking Machines				1/2–2
Pumps, Pool & Illum. Fountain				1/4–5
Pumps, Roof Storage Tank				7½–25
Pumps, Sump				1/4–3
Pumps, Vacuum				2–5
Razors, Electric	6–15			
Refrigerators		1/8–1/3		1/3–2
Saws, Band (Home Work Shop)		1/4–1/2		
Sharpeners, Razor Blade	15–30		15–30	
Softeners, Water		1/12–1/8		
Sprayers, Paint & Insecticide		1/20–1/6		
Stage, Curtain Control Motor				1/4–1
Stage, Orchestra Lift				15–25

Irons, Flat	200–1000		500–2500		Softeners, Water		1/12–1/8		
Irons, Soldering	60–500		200–400		Sprayers, Paint & Insecticide		1/20–1/6		
Irons, Waffle	300–1320		1–3 Kw.		Stage, Curtain Control Motor				1/4–1
Lamps Health and Sun	30–1500		250–1500		Stage, Orchestra Lift				15–25
Lighters, Cigarette & Cigar	–75		–75		Stage, Organ Lift				3–7½
Machines, Pop Corn Vending			3–6 Kw.		Stokers, Coal		1/6–1/3		1/2–5
Makers, Coffee	450–750		1–6 Kw.		Trains, Toy	40–100			
Ovens, Baking & Roasting	660–2400		5–15 Kw.		Tumblers, Laundry Drying				3–10
Ovens, Bread & Pie			12–55 Kw.		Vibrators, Massage		1/50–1/20		1/20–1/8
Ovens, Industrial Annealing			5–30 Kw.		Washers, Clothes		1/8–1/4		
Ovens, Industrial Enamelling			10–100 Kw.		Washers, Dish		–1/4		1/2–5
Pads Heating	50–60		50–60		Washers, Steam Laundry				3–15
Percolators	300–450								
Plates, Hot, Grills, Griddle Table Stoves	480–6000		1–6 Kw.						
Poppers, Corn	450–660								
Pots, Glue			100–1500						
Pressers, Trousers & Tie	37–		500–1500						
Ranges	5–10 Kw.		8–25 Kw.						
Roaster	1–2 Kw.								
Sterilizers, Dental & Doctor			1000–3000						
Toasters, Bread & Sandwich	420–1400		2–5.5 Kw.						
Toys, Electric	50–1175								
Waffle Iron	1–2 Kw.		2–6 Kw.						
Warmers, Bottle	300–600								
Warmers, Cafeteria Food			4–6 Kw.						
Warmers, Plate	110–500		1–2 Kw.						
Warmers, Soup & Seafood			450–1000						
Vaporizers, Medicated Solution	75–330								
MOTOR-OPERATED EQUIPMENT					**MAGNETS, RECTIFIERS, TRANSFORMERS**				
Blowers, Organ		1–3		2–7½	Charges, Battery	600–750		1–15 Kw.	
Blowers, Pneumatic Tube Systems				10–30	Closers, Window, Magnetic	500–1000			
Blowers, Portable Cleaning				1/6–3	Dia-Therm. Therapeutic			250–750	
Burners, Oil		1/6		1/4–5	Door Locks, Apt. House	6–9			
Cash Registers				1/20–1/8	Electroplating			5–20 Kw.	
Churns, Butter		1/8–1/2			Furnaces, Induction			5–500 Kw.	
Cleaners, Vacuum Built-in		1/2–5		1–7½	Magnets, Lifting Metal			4–15 Kw.	
Cleaners, Vacuum Portable		1/30–1/3			Magnets, Metal Extracting			1½–5 Kw.	
Clippers, Hedge		1/30–1/4			Ozonators, Room Air Purific			.5–3 Kw.	
Clocks, Motor Operated				1/50–1/4	School Laboratory Panel			5–50 Kw.	
Compressors, Air (Gasoline Station)				1–5	Transformers, Bell Ringing	25–50			
Compressors, Air (Temp. Regul. System)		1/4–2		1/2–3	Transformers, Signal Systems			50–500	
Compressors, Refrigeration				5–500	Valves, Gas & Liquids, 1-in. & Less			200–1000	
Conditioners, Air (Room Types)		1/100–5		1/4–5	Valves, Above 1-in.			500–3000	
Coolers, Water		1/8–1/3		1/8–1/3	Welders, Light Duty Spot & Arc			3–20 Kw.	
Cranes, Travelling Lift				5–30	Welders, Heavy Duty & Arc			20–100 Kw.	
Cranes, Travelling Bridge				1–7½	X-Ray—Dental & Doctor			2–25 Kw.	
Dimmer Lever Drives				½–1½	X-Ray Hospital			10–40 Kw.	
Dental Chair Units			500–1500		**ALARM AND SIGNALLING EQUIPMENT**				
Door Openers, Private Garage		1/8–1			Alarms, Burglar	10–60		100–1000	
Door Openers, Shipping Docks				1/4–2	Alarms, Fire	10–60		100–1000	
Drills, Portable 1/8 to 1/2-in.				1/6–1/4	Amplifiers, Radio Distribution			200–1000	
Drills, Portable 5/8 & Larger				1/4–1	Annunciators, Homes ⅝- to 2½-in Lamps, Each	1.8–2.4			
Dumbwaiters				1/2–5	Annunciators, Large Systems—(110-Volt Lamps, Each)	–10		–10	
Elevators, 1-Ton Freight				3–10	Bells, 2½-in. to 4-in.	5–10		5–10	
Elevators 5-Ton Freight				7½–20	Bells, Larger			10–30	
Elevators 10 Pass				7½–20	Bells, Church Systems				1/2–2
Elevators 25 Pass				10–50	Buzzers	5–6		5–6	
Escalators				10–40	Chimes, Door Single and Multiple-Tone	15–25		15–25	
Exercisers		1/6–1/4		1/6–1/4	Chimes, Church Systems				1/2–2
Extractors Juice		1/10–1/4		1/10–1/4	Clocks, Master Impulse	1–2		1–2	
					Clocks, Secondary Type	.5–1		.5–1	
					Gongs, Horns, Howlers	10–30		10–30	
					Radio, Amateur Transmitting	100–2000			
					Radio, Home Receivers	100–500			
					Sirens, Small & Heavy-duty			65–250	1–7½
					Speakers, Dynamic			30–40	
					Television	500–750			
					Whistles, Air Valve	4–10		4–10	
					Whistles, Motor Compressor				1/20–1

LOADS FOR GENERAL ILLUMINATION FROM

In many cases the desirable footcandle intensity is much higher than that obtainable from prevailing practice in general illumination. In such instances, designated by (*), the watts per sq ft. values specified are intended to provide only for the general illumination needed, and supplementary illumination must be provided by local or localized general methods. The load considerations are thus entirely dependent on specific studies of machine spacing, actual size of areas requiring high intensities, color control, special glare or directional features, degree.

Occupancy	Watts per Sq. Ft.
1. AISLES, STAIRWAYS, PASSAGEWAYS	
10 watts per running foot.	
2. ASSEMBLY	
a. Rough	3.0
b. Medium	4.5
c. Fine	*4.5
d. Extra Fine	*4.5
3. AUTOMOBLIE MANUFACTURING	
a. Assembly Line	*4.5
b. Frame Assembly	3.0
c. Body Assembly	4.5
d. Body Finishing and Inspecting	*4.5
4. BAKERIES	4.0
5. BOOK BINDING	
a. Folding, Assembling, Pasting	3.0
b. Cutting, Punching, Stitching, Embossing	4.0
6. BREWERIES	
a. Brew House	3.0
b. Boiling, Keg Washing, etc.	3.0
c. Bottling	4.0
7. CANDY MAKING	4.0
8. CANNING AND PRESERVING	4.0
9. CHEMICAL WORKS	
a. Hand Furnaces, Stationary Driers and Crystallizers	2.0
b. Mechanical Driers and Crystallizers, Filtrations, Evaporators, Bleaching	2.0
c. Tanks for Cooking, Extractors, Percolators, Nitrators, Electrolytic Cells	3.0
10. CLAY PRODUCTS AND CEMENTS	
a. Grinding, Filter Presses, Kiln Rooms	2.0
b. Moldings, Pressing, Cleaning, Trimming	2.0
c. Enameling	3.0
d. Glazing	4.0
11. CLOTH PRODUCTS	
a. Cutting, Inspecting, Sewing	
(1) Light Goods	4.5
(2) Dark Goods	*4.5
b. Pressing, Cloth Treating (Oil Cloth, etc.)	
(1) Light Goods	3.0
(2) Dark Goods	6.0
12. COAL BREAKING, WASHING, SCREENING	2.0
13. DAIRY PRODUCTS	4.0
14. ENGRAVING	*4.5
15. FORGE SHOPS	
a. Welding	2.0
16. FOUNDRIES	
a. Charging Floor, Tumbling, Cleaning, Pouring, Shaking Out	2.0
b. Rough Molding and Core Making	2.0
c. Fine Molding and Core Making	4.0
17. GARAGES	
a. Storage	2.0
b. Repair and Washing	*3.0
18. GLASS WORKS	
a. Mixing and Furnace Rooms, Pressing and Lehr Glass Blowing Machines	3.0
b. Grinding, Cutting Glass to Size, Silvering	4.5
c. Fine Grinding, Polishing, Beveling, Etching, Inspecting, etc.	*4.5
19. GLOVE MANUFACTURING	
a. Light Goods	
(1) Cutting, Pressing, Knitting, Sorting	4.5
(2) Stitching, Trimming, Inspecting	4.5
b. Dark Goods	
(1) Cutting, Pressing, etc.	*4.5
(2) Stitching, Trimming, etc.	*4.5
20. HANGARS—AEROPLANE	
a. Storage—Live	2.0
b. Repair Department	*3.0
21. HAT MANUFACTURING	
a. Dyeing, Stiffening, Braiding, Cleaning and Refining	
(1) Light	2.0
(2) Dark	4.5
b. Forming, Sizing, Pouncing, Flanging, Finishing and Ironing.	
(1) Light	3.0
(2) Dark	6.0
c. Sewing	
(1) Light	4.5
(2) Dark	*4.5
22. ICE MAKING	
a. Engine and Compressor Room	2.0
23. INSPECTION	
a. Rough	3.0
b. Medium	4.5
c. Fine	*4.5
d. Extra Fine	*4.5
24. JEWELRY AND WATCH MANUFACTURING	*4.5
25. LAUNDRIES AND DRY CLEANING	4.5
26. LEATHER MANUFACTURING	
a. Vats	2.0
b. Cleaning, Tanning and Stretching	2.0
c. Cutting, Fleshing and Stuffing	3.0
d. Finishing and Scarfing	4.5
27. LEATHER WORKING	
a. Pressing, Winding and Glazing	
(1) Light	2.0
(2) Dark	4.5
b. Grading, Matching, Cutting, Scarfing, Sewing	
(1) Light	4.5
(2) Dark	*4.5
28. LOCKER ROOMS	2.0
29. MACHINE SHOPS	
a. Rough Bench and Machine Work	3.0
b. Medium Bench and Machine Work, Ordinary Automatic Machines, Rough Grinding, Medium Buffing and Polishing	4.5
c. Fine Bench and Machine Work, Fine Automatic Machines, Medium Grinding, Fine Buffing and Polishing	*4.5
d. Extra Fine Bench and Machine Work, Grinding	
(1) Fine Work	*4.5
30. MEAT PACKING	
a. Slaughtering	2.0
b. Cleaning, Cutting, Cooking, Grinding, Canning, Packing	4.5
31. MILLING—GRAIN FOODS	
a. Cleaning, Grinding and Rolling	2.0
b. Baking or Roasting	4.5
c. Flour Grading	4.5
32. OFFICES	
a. Private and General	
(1) No close work	3.0
(2) Close work	4.5
b. Drafting Rooms	7.0

OVERHEAD SOURCES IN INDUSTRIAL OCCUPANCIES

of precision of work, and similar factors which necessitate special study.

These figures are based upon the use of modern high efficiency light sources such as fluorescent and mercury vapor lamps. To achieve equal illumination intensities with incandescent lamps approximately double the watts per square foot values shown will be required.

Where machines or operations require supplementary illumination add 2 watts per square foot for the area involved.

Occupancy	Watts per Sq. Ft.
33. PACKING AND BOXING	3.0
34. PAINT MANUFACTURING	3.0
35. PAINT SHOPS	
a. Dipping, Spraying, Firing, Rubbing, Ordinary Hand Painting and Finishing	3.0
b. Fine Hand Painting and Finishing	*3.0
c. Extra Fine Hand Painting and Finishing (Automobile Bodies, Piano Cases, etc.)	*3.0
36. PAPER BOX MANUFACTURING	
a. Light	3.0
b. Dark	4.0
c. Storage of Stock	2.0
37. PAPER MANUFACTURING	
a. Beaters, Grinding, Calendering	2.0
b. Finishing, Cutting, Trimming	4.5
38. PLATING	2.0
39. POLISHING AND BURNISHING	3.0
40. POWER PLANTS, ENGINE ROOMS, BOILERS	
a. Boilers, Coal and Ash Handling, Storage Battery Rooms	2.0
b. Auxiliary Equipment, Oil Switches and Transformers	2.0
c. Switchboards, Engines, Generators, Blowers, Compressors	3.0
41. PRINTING INDUSTRIES	
a. Matrixing and Casting	2.0
b. Miscellaneous Machines	3.0
c. Presses and Electrotyping	4.5
d. Lithographing	*4.5
e. Linotype, Monotype, Typesetting, Imposing Stone, Engraving	*4.5
f. Proof Reading	*4.5
42. RECEIVING AND SHIPPING	2.0
43. RUBBER MANUFACTURING AND PRODUCTS	
a. Calendars, Compounding Mills, Fabric Preparation, Stock Cutting, Tubing Machines, Solid Tire Operations, Mechanical Goods Building, Vulcanizing	3.0
b. Bead Building, Pneumatic Tire Building and Finishing, Inner Tube Operation, Mechanical Goods Trimming, Treading	4.5
44. SHEET METAL WORKS	
a. Miscellaneous Machines, Ordinary Bench Work	3.0
b. Punches, Presses, Shears, Stamps, Welders, Spinning, Medium Bench Work	4.5
c. Tin Plate Inspection	*4.5
45. SHOE MANUFACTURING	
a. Hand Turning, Miscellaneous Bench and Machine Work	2.0
b. Inspecting and Sorting Raw Material, Cutting and Stitching	
(1) Light	4.5
(2) Dark	*4.5
c. Lasting and Welting	4.5
46. SOAP MANUFACTURING	
a. Kettle Houses, Cutting, Soap Chip and Powder	3.0
b. Stamping, Wrapping and Packing, Filling and Packing Soap Powder	4.5
47. STEEL AND IRON MILLS, BAR, SHEET AND WIRE PRODUCTS	
a. Soaking Pits and Reheating Furnaces	2.0
b. Charging and Casting Floors	2.0
c. Muck and Heavy Rolling, Shearing (Rough by Gauge), Pickling and Cleaning	2.0
d. Plate Inspection, Chipping	*4.5
e. Automatic Machines, Light and Cold Rolling, Wire Drawing, Shearing (fine by line)	4.5
48. STONE CRUSHING AND SCREENING	
a. Belt Conveyor Tubes, Main Line Shafting Spaces, Chute Rooms, Inside of Bins	2.0
b. Primary Breaker Room, Auxiliary Breakers under Bins	2.0
c. Screens	3.0
49. STORAGE BATTERY MANUFACTURING	
a. Molding of Grids	3.0
50. STORE AND STOCK ROOMS	
a. Rough Bulky Material	2.0
b. Medium or Fine Material requiring care	3.0
51. STRUCTURAL STEEL FABRICATION	3.0
52. SUGAR GRADING	5.0
53. TESTING	
a. Rough	3.0
b. Fine	4.5
c. Extra Fine Instruments, Scales, etc.	*4.5
54. TEXTILE MILLS	
a. Cotton	
(1) Opening and Lapping, Carding, Drawing, Roving, Dyeing	3.0
(2) Spooling, Spinning, Drawing, Warping, Weaving, Quilling, Inspecting, Knitting, Slashing (over beam end)	4.5
b. Silk	
(1) Winding, Throwing, Dyeing	4.5
(2) Quilling, Warping, Weaving, Finishing	
Light Goods	4.5
Dark Goods	6.0
c. Woolen	
(1) Carding, Picking, Washing, Combing	3.0
(2) Twisting, Dyeing	3.0
(3) Drawing-in, Warping—	
Light Goods	4.5
Dark Goods	6.0
(4) Weaving—	
Light Goods	4.5
Dark Goods	6.0
(5) Knitting Machines	4.5
55. TOBACCO PRODUCTS	
a. Drying, Stripping, General	3.0
b. Grading and Sorting	*4.5
56. TOILETS AND WASH ROOMS	2.0
57. UPHOLSTERING	
a. Automobile, Coach, Furniture	4.5
58. WAREHOUSE	2.0
59. WOODWORKING	
a. Rough Sawing and Bench Work	2.0
b. Sizing, Planing, Rough Sanding, Medium Machine and Bench Work, Gluing, Veneering, Cooperage	4.5
c. Fine Bench and Machine Work, Fine Sanding and Finishing	6.0

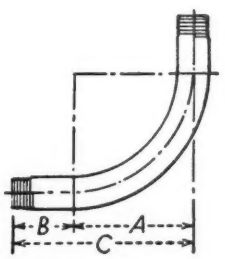
STANDARD LOADS FOR ILLUMINATION IN COMMERCIAL AND PUBLIC INTERIORS

Occupancy	Watts per Sq. Ft.
1. Armories	
Drill Sheds and Exhibition Halls. This does not include lighting circuits for demonstration booths, special exhibit spaces, etc.	3.0
2. Art Galleries	
a. General	2.0
b. On Paintings—50 watts per running foot of usable wall area.	
3. Auditoriums	2.0
4. Automobile Show Rooms	4.5
5. Banks	
a. Lobby	3.0
b. Counters—50 watts per running foot including service for signs and small motor applications, etc.	
c. Offices and Cages	4.5
6. Barber Shop and Beauty Parlors. This does not include circuits for special equipment.	4.5
7. Billiards	
a. General	3.0
b. Tables—450 watts per table.	
8. Bowling	
a. Alley Runway and Seats	3.0
b. Pins—300 watts per set of pins.	
9. Churches	
a. Auditoriums	2.0
b. Sunday School Rooms	3.0
c. Pulpit or Rostrum	3.0
10. Club Rooms	
a. Lounge	2.0
b. Reading Rooms. The above two uses are so often combined that the higher figure is advisable. It includes provision for convenience outlets.	4.5
11. Court Rooms	4.5
12. Dance Halls. No allowance has been included for spectacular lighting, spots, etc.	2.0
13. Drafting Rooms	6.0
14. Fire Engine Houses	2.0
15. Gymnasiums	
a. Main Floor	3.0
b. Shower Rooms	2.5
c. Locker Rooms	2.0
d. Fencing, Boxing, etc.	4.0
e. Handball, Squash, etc.	5.0
16. Halls and Interior Passageways—15 watts per running foot.	
17. Hospitals	
a. Lobby, Reception Room	2.5
b. Corridors—10 watts per running foot.	
c. Wards. Including allowance for convenience outlets for local illumination.	3.0
d. Private Rooms. Including allowance for convenience outlets for local illumination.	4.5
e. Operating Room	4.5
f. Operating Tables or Chairs. Major Surgeries—3000 watts per area. Minor Surgeries—1500 watts per area. This and the above figure include allowance for directional control. Special wiring for emergency systems must also be considered.	
g. Laboratories	4.0
18. Hotels	
a. Lobby. Not including provision for conventions, exhibits.	3.0
b. Dining Room	3.5
c. Kitchen	3.0
d. Bed Rooms. Including allowance for convenience outlets.	3.0
e. Corridors—10 watts per running foot.	
f. Writing Room. Including allowance for convenience outlets.	4.5
19. Library	
a. Reading Rooms. This includes allowance for convenience outlets.	6.0
b. Stack Room—12 watts per running foot of facing stacks.	
20. Motion Picture Houses and Theatres	
a. Auditoriums	2.0
b. Foyer	2.5
c. Lobby	3.0
21. Museums	
a. General	2.5
b. Special exhibits—supplementary lighting	2.5
22. Office Buildings	
a. Private Offices, no close work	3.0
b. Private Offices, with close work	5.0
c. General Offices, no close work	2.5
d. General Offices, with close work	4.5
e. File Room, Vault, etc.	2.5
f. Reception Room	2.0
23. Post Office	
a. Lobby	2.5
b. Sorting, Mailing, etc.	4.5
c. Storage, File Room, etc.	2.0
24. Professional Offices	
a. Waiting Rooms	2.5
b. Consultation Rooms	4.5
c. Operating Offices	4.5
d. Dental Chairs—600 watts per chair.	
25. Railway	
a. Depot—Waiting Room	2.5
b. Ticket Offices—General. On Counters 50 watts per running foot.	3.0
c. Rest Room, Smoking Room	2.5
d. Baggage Checking Office	3.0
e. Baggage Storage	2.0
f. Concourse	2.0
g. Train Platform	2.0
26. Restaurants, Lunch Rooms and Cafeterias	
a. Dining Area	2.5
b. Food Displays—50 watts per running foot of counter (including service aisle).	
27. Schools	
a. Auditoriums. If to be used as a study hall—4.5 watts per sq. ft.	2.5
b. Class and Study Rooms	4.5
c. Drawing Room	6.0
d. Laboratories	4.5
e. Manual Training	4.0
f. Sewing Room	6.0
g. Sight Saving Classes	6.0
28. Show Cases—25 watts per running foot.	
29. Show Windows	
a. *Large Cities. Brightly Lighted District—350 watts per running foot of glass. Secondary Business Locations—250 watts per running foot of glass. Neighborhood Stores—150 watts per running foot of glass.	
b. *Medium Cities. Brightly Lighted District—250 watts per running foot of glass. Neighborhood Stores—150 watts per running foot of glass frontage.	
c. *Small Cities and Towns—150 watts per running foot of glass frontage.	
d. Lighting to Reduce Daylight Window Reflections—750 watts per running foot of glass.	
30. Stores, Large Department and Specialty	
a. Main Floor	4.5
b. Other Floors	4.5
31. Stores in Outlying Districts	4.5
32. Wall Cases—25 watts per running foot.	

* Wattages shown are for white light with incandescent filament lamps. Where color is to be used, wattages should be doubled. Values may be reduced 10 percent for glass on two sides of window, 25 percent for glass on three sides of window and 40 percent for island windows.

RIGID METAL CONDUIT—WEIGHTS AND DIMENSION

Conduit								Elbows		
Trade size, inches	Length	Nominal weight, pounds per foot	External diameter, inches	Nominal internal diameter, inches	Nominal wall thickness inches	Minimum weight 10 lengths, pounds	Threads per inch	Nominal weight, pounds per 100	Dimensions, inches		
									A	B	C
½	9′ 11½″	0.852	0.840	0.622	0.109	79	14	83	4	2½	6½
¾	9′ 11½″	1.134	1.050	0.824	0.113	105	14	123	4½	2¾	7¼
1	9′ 11½″	1.684	1.315	1.049	0.133	153	11½	203	5¾	2⅞	8⅝
1¼	9′ 11″	2.281	1.660	1.380	0.140	201	11½	318	7¼	2¾	10
1½	9′ 11″	2.731	1.900	1.610	0.145	249	11½	432	8¼	2¾	11
2	9′ 11″	3.678	2.375	2.067	0.154	334	11½	705	9½	4⅛	13⅜
2½	9′ 10½″	5.819	2.875	2.469	0.203	527	8	1,261	10½	5 3/16	15 11/16
3	9′ 10½″	7.616	3.500	3.068	0.216	690	8	1,840	13	4¾	17¾
3½	9′ 10″	9.202	4.000	3.548	0.226	831	8	2,530	15	5	20
4	9′ 10″	10.889	4.500	4.026	0.237	982	8	3,176	16	5 5/16	21 5/16
4½	9′ 10″	12.642	5.000	4.506	0.247	1,150	8	4,110	18	5½	23½
5	9′ 9″	14.810	5.563	5.047	0.258	1,344	8	6,170	24	5	29
6	9′ 9″	19.185	6.625	6.065	0.280	1,770	8	9,590	30	6½	36½



ELECTRICAL METALLIC TUBING—WEIGHTS AND DIMENSIONS

Sizes, inches	Approximate weight per 1000 ft., pounds	Diameter inches	
		Internal	External
⅜	254	0.493	0.577
½	321	0.622	0.706
¾	488	0.824	0.922
1	711	1.049	1.163
1¼	985	1.380	1.508
1½	1141	1.610	1.738
2	1470	2.067	2.195

SIGNALLING AND COMMUNICATION SYSTEM—RACEWAY SIZES FOR TWISTED PAIRS AND SINGLE CONDUCTORS

Size Raceway	Minimum Radius of Bends Inches	Number of Twisted Pairs No.19 gage	Number of R.C. Single Conductors		
			No.18 gage Fixture Wire	No.16 gage Fixture Wire	No.14 gage
½ in.	5	3	10	5	4
¾ in.	6	6	16	9	7

No run of raceway to exceed 100 ft. in length or to include more than two 90-degree bends.

RACEWAY SIZES FOR LEAD-COVERED TELEPHONE CABLES, NO. 22 CONDUCTORS (OR NOT OVER FOUR NO. 18 CONDUCTORS)

Number of Pairs	Trade Size Raceway Inches	Minimum Radius of Bends Inches	Number of Pairs	Trade Size Raceway Inches	Minimum Radius of Bends Inches
10 or less	¾	6	51 to 100	1½	12
11 to 25	1	8	101 to 200	2	12
26 to 50	1¼	12	201 to 400	3½	18

No run of raceway to exceed 100 ft. in length or to include more than two 90-degree bends.

PLATE SIZES

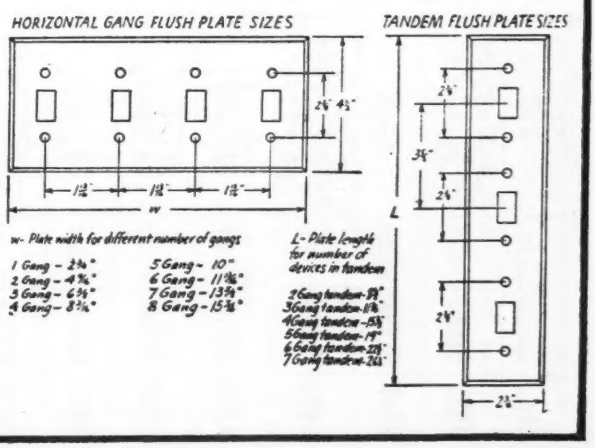


TABLE 1—ALLOWABLE CURRENT-CARRYING CAPACITIES OF CONDUCTORS IN AMPERES

Not More Than Three Conductors in Raceway or Cable

(Based on Room Temperature of 30 C. 86 F.)

Size AWG MCM	Rubber Type R Type RW Type RU (14–8) / Thermoplastic Type T (14–410) Type TW (14–410)	Rubber Type RH	Paper / Thermoplastic Asbestos Type TA / Var-Cam Type V / Asbestos Var-Cam Type AVB	Asbestos Var-Cam Type AVA Type AVL	Impregnated Asbestos Type AI (14–8) Type AIA	Asbestos Type A (14–8) Type AA
14	15	15	25	30	30	30
12	20	20	30	35	40	40
10	30	30	40	45	50	55
8	40	45	50	60	65	70
6	55	65	70	80	85	95
4	70	85	90	105	115	120
3	80	100	105	120	130	145
2	95	115	120	135	145	165
1	110	130	140	160	170	190
0	125	150	155	190	200	225
00	145	175	185	215	230	250
000	165	200	210	245	265	285
0000	195	230	235	275	310	340
250	215	255	270	315	335	...
300	240	285	300	345	380	...
350	260	310	325	390	420	...
400	280	335	360	420	450	...
500	320	380	405	470	500	...
600	355	420	455	525	545	...
700	385	460	490	560	600	...
750	400	475	500	580	620	...
800	410	490	515	600	640	...
900	435	520	555	...	...	...
1,000	455	545	585	680	730	...
1,250	495	590	645	...	...	...
1,500	520	625	700	785	...	...
1,750	545	650	735	...	...	...
2,000	560	665	775	840	...	...

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER 30 C. 86 F.

C.	F.						
40	104	.82	.88	.90	.94	.95	...
45	113	.71	.82	.85	.90	.92	...
50	122	.58	.75	.80	.87	.89	...
55	131	.41	.67	.74	.83	.86	...
60	140	...	.58	.67	.79	.83	.91
70	158	...	.35	.52	.71	.76	.87
75	167	...	...	.43	.66	.72	.86
80	176	...	...	.30	.61	.69	.84
90	194	...	...	...	.50	.61	.80
100	212	...	...	...	...	.51	.77
120	248	...	...	...	...	...	.69
140	284	...	...	...	...	...	.59

See Notes Following Tables 1 and 2

TABLE 2—ALLOWABLE CURRENT-CARRYING CAPACITIES OF CONDUCTORS IN AMPERES

Single Conductor in Free Air

(Based on Room Temperature of 30 C. 86 F.)

Size AWG MCM	Rubber Type R Type RW Type RU (14–6) / Thermoplastic Type T Type TW	Rubber Type RH	Thermoplastic Asbestos Type TA / Var-Cam Type V / Asbestos Var-Cam Type AVB	Asbestos Var-Cam Type AVA Type AVL	Impregnated Asbestos Type AI (14–8) Type AIA	Asbestos Type A (14–8) Type AA	Slow-Burning Type SB / Weather-proof Type WP Type SBW
14	20	20	30	40	40	45	30
12	25	25	40	50	50	55	40
10	40	40	55	65	70	75	55
8	55	65	70	85	90	100	70
6	80	95	100	120	125	135	100
4	105	125	135	160	170	180	120
3	120	145	155	180	195	210	150
2	140	170	180	210	225	240	175
1	165	195	210	245	265	280	205
0	195	220	245	285	305	325	235
00	225	265	285	330	355	370	275
000	260	310	330	385	410	430	320
0000	300	360	385	445	475	510	370

TABLE 2—Continued

Size AWG MCM	Rubber Type R Type RW Type RU (14–6) / Thermoplastic Type T Type TW	Rubber Type RH	Thermoplastic Asbestos Type TA / Var-Cam Type V / Asbestos Var-Cam Type AVB	Asbestos Var-Cam Type AVA Type AVL	Impregnated Asbestos Type AI (14–8) Type AIA	Asbestos Type A (14–8) Type AA	Slow-Burning Type SB / Weather-proof Type WP Type SBW
250	340	405	425	495	530	....	410
300	375	445	480	555	590	....	460
350	420	505	530	610	655	....	510
400	455	545	575	665	710	....	555
500	515	620	660	765	815	....	630
600	575	690	740	855	910	....	710
700	630	755	815	940	1005	....	780
750	655	785	845	980	1045	....	810
800	680	815	880	1020	1085	....	845
900	730	870	940	....	....	....	905
1000	780	935	1000	1165	1240	....	965
1250	890	1065	1130	....	....	....	....
1500	980	1175	1260	1450	....	....	1215
1750	1070	1280	1370	....	....	....	....
2000	1155	1385	1470	1715	....	....	1405

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER 30 C. 86 F.

C.	F.							
40	104	.82	.88	.90	.94	.95	....	....
45	113	.71	.82	.85	.90	.92	....	....
50	122	.58	.75	.80	.87	.89	....	....
55	131	.41	.67	.74	.83	.86	....	....
60	140	....	.58	.67	.79	.83	.91	....
70	158	....	.35	.52	.71	.76	.87	....
75	167	....	....	.43	.66	.72	.86	....
80	176	....	....	.30	.61	.69	.84	....
90	194	....	....	....	.50	.61	.80	....
100	212	....	....	....	....	.51	.77	....
120	248	....	....	....	....	....	.69	....
140	284	....	....	....	....	....	.59	....

See notes following Tables 1 and 2.

TABLE 3—ALLOWABLE CURRENT-CARRYING CAPACITY OF FLEXIBLE CORD AND FIXTURE WIRE IN AMPERES

(Based on Room Temperature of 30 C. 86 F.)

Size AWG	Flexible Cord: Rubber and Cotton Types CT, CTJ / Rubber and Asbestos Types AT, ATJ	Rubber Types PO, C, PD, P, PWP, K, E, EH / Armored Type CA	Rubber Types S, SO, SJ, SJO, SV, POSJ / Thermoplastic Types ST, SJT, SVT, POT	Types AFS, AFSJ, HC, HPD, HSJ	Types AVPO AVPD	Cotton Types CFC* CFPO* CFPD* / Asbestos Types AFC* AFPO* AFPD*	Fixture Wire: Rubber Types RF-64 RF-33 FF-64 FF-33	Thermoplastic Types TF TFF / Cotton Type CF* / Asbestos Type AF*
27**	0.5							
18	...	5	7	10	17	6	5	6
17	..			12				
16	..	7	10	15	22	8	7	8
15	..	..		17			..	
14	..	15	15	20	28	17	..	17
12	..	20	20	..	36	..	..	..
10	..	25	25	..	47	..	..	..
8	..	35	..	..	..	..	..	..
6	..	45	..	..	..	..	..	..
4	..	60	..	..	..	..	..	..
3	..	80	..	..	..	..	..	..

*These types are used almost exclusively in fixtures where they are exposed to high temperatures and ampere ratings are assigned accordingly.

**Tinsel cord.

MORE THAN THREE CONDUCTORS IN A CORD

Table 3 gives the allowable current-carrying capacities for not more than three current-carrying conductors in a cord. If the number of current-carrying conductors in a cord is from four to six the allowable current-carrying capacity of each conductor shall be reduced to 80 per cent of the values in the table.

TABLE 4—NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

Rubber Covered, Types RF-32, R, RH, RW and RU Thermoplastic, Types TF, T and TW One to Nine Conductors

For more than nine conductors see Table 9.
(See section 3013)

Size AWG MCM	Number of Conductors in One Conduit or Tubing								
	1	2	3	4	5	6	7	8	9
18	½	½	½	½	½	½	½	¾	¾
16	½	½	½	½	½	½	¾	¾	¾
14	½	½	½	½	¾	¾	1	1	1
12	½	½	½	¾	¾	1	1	1	1¼
10	½	¾	¾	¾	1	1	1	1¼	1¼
8	½	¾	¾	1	1¼	1¼	1¼	1½	1½
6	¾	1	1	1¼	1½	1½	2	2	2
4	¾	1¼	*1¼	1¼	1½	2	2	2	2½
3	¾	1¼	1¼	1½	2	2	2	2½	2½
2	¾	1¼	1¼	2	2	2	2½	2½	3½
1	¾	1½	1½	2	2½	2½	2½	3	3
0	1	1½	2	2	2½	2½	3	3	3
00	1	2	2	2½	2½	3	3	3½	3½
000	1	2	2	2½	3	3	3	3½	4
0000	1¼	2	2½	3	3	3	3½	3½	4
250	1¼	2½	3½	3	3	3½	4	4	4½
300	1¼	3½	2½	3	3½	4	4	4½	4½
350	1¼	3	3	3½	3½	4	4½	4½	5
400	1¼	3	3	3½	4	4	4½	5	5
500	1¼	3	3	3½	4	4½	5	5	6
600	2	3½	3½	4	4½	5	6	6	6
700	2	3½	3½	4½	5	5	6	6	...
750	2	3½	3½	4½	5	6	6	6	...
800	2	3½	4	4½	5	6	6	...	...
900	2	4	4	5	6	6	6	...	...
1000	2	4	4	5	6	6	...	...	...
1250	2½	4½	4½	6	6	...	...	...	...
1500	3	5	5	6	...	...	...	...	...
1750	3	5	6	6	...	...	...	...	...
2000	3	6	6	...	...	...	...	...	...

See Note 5 to Tables 1 and 2.
*Where a service run of conduit or electrical metallic tubing does not exceed 50 feet in length and does not contain more than the equivalent of two quarter bends from end to end two No. 4 insulated and one No. 4 bare conductors may be installed in 1-inch conduit or tubing.

TABLE 5—NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

Lead-Covered Types RL and RHL—600 V.

(See sections 3466 and 3487)

Size AWG MCM	Number of Conductors in One Conduit or Tubing											
	Single Conductor Cable				2-Conductor Cable				3-Conductor Cable			
	1	2	3	4	1	2	3	4	1	2	3	4
14	½	¾	¾	1	¾	1	1	1¼	¾	1¼	1½	1½
12	½	¾	¾	1	¾	1	1¼	1¼	1	1¼	1½	2
10	½	¾	1	1	¾	1¼	1¼	1½	1	1½	2	2
8	½	1	1¼	1½	1	1¼	1½	2	1	2	2	2½
6	¾	1¼	1½	1½	1¼	1½	2	2½	1¼	2½	3	3
4	¾	1¼	1½	1½	1½	2	2½	2½	1½	3	3	3½
3	¾	1½	1½	2	1½	2	2½	3	1½	3	3	3½
2	1	1¼	1½	2	1¼	2	2½	3	1½	3	3½	4
1	1	1½	2	2	1½	2½	3	3½	2	3½	4	4½
0	1	2	2	2½	2	2½	3	3½	2	4	4½	5
00	1	2	2	2½	2	3	3½	4	2½	4	4½	5
000	1¼	2	2½	2½	2	3	3½	4	2½	4½	4½	6
0000	1¼	2½	2½	3	2½	3	3½	4½	3	5	6	6
250	1¼	2½	3	3	....	....	....	....	3	6	6	....
300	1½	3	3	3½	....	....	....	....	3½	6	6	....
350	1½	3	3	3½	....	....	....	....	3½	6	6	....
400	1½	3	3	3½	....	....	....	....	3½	6	6	....
500	1½	3	3½	4	....	....	....	....	4	6	....	....
600	2	3½	4	4½	....	....	....	....	....	....	....	....
700	2	4	4	5	....	....	....	....	....	....	....	....
750	2	4	4	5	....	....	....	....	....	....	....	....
800	2	4	4½	5	....	....	....	....	....	....	....	....
900	2½	4	4½	5	....	....	....	....	....	....	....	....
1000	2½	4½	4½	6	....	....	....	....	....	....	....	....
1250	3	5	5	6	....	....	....	....	....	....	....	....
1500	3	5	6	6	....	....	....	....	....	....	....	....
1750	3	6	6	....	....	....	....	....	....	....	....	....
2000	3½	6	6	....	....	....	....	....	....	....	....	....

TABLE 9—NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

More Than Nine Conductors Rubber-Covered Types RF-32, R, RH, RW, RU, Thermoplastic Types TE, T, and TW

*When Specially Permitted by This Code
(See section 3013)

Size AWG	Maximum Number of Conductors in Conduit or Tubing						
	¾ Inch	1 Inch	1¼ Inch	1½ Inch	2 Inch	2½ Inch	3 Inch
18	12	20	35	49	80	115	176
16	10	17	30	41	68	97	150
14		10	18	25	40	59	90
12			15	21	35	50	77
10			13	17	29	41	64
8				10	17	25	38
6						15	23

*More than nine conductors are permitted in a single conduit for conductors between a motor and its controller; stage pocket and border circuits, section 5212; sign flashers, section 6021-d; elevator control conductors, section 6214.

TABLE 11—COMBINATION OF CONDUCTORS

(See sections 3466 and 3487)

For groups or combinations of conductors not included in the Tables 4 to 9, it is recommended that the conduit or tubing be of such size that the sum of the cross-sectional areas of the individual conductors will not be more than the percentage of the interior cross-sectional area of the conduit or tubing than as shown in the following table:

Per Cent Area of Conduit or Tubing

	Number of Conductors				
	1	2	3	4	Over 4
Conductors (not lead covered)	53	31	43	40	40
Lead-covered conductors	55	30	40	38	35
For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions.	60	40	50	50	50

For carrying capacity of more than three conductors in a conduit or tubing, see Tables 1 and 2, Note 4.
See Tables 13 to 19 for dimensions of conductors, conduit and tubing.

TABLE 16—DIMENSIONS OF LEAD-COVERED CONDUCTORS

Types RL and RHL

Size AWG-MCM	Single Conductor		Two Conductor		Three Conductor	
	Diam. Inches	Area Sq. Ins.	Diam. Inches	Area Sq. Ins.	Diam. Inches	Area Sq. Ins.
14	.28	.062	.28 x .47	.115	.59	.273
12	.29	.066	.31 x .54	.146	.62	.301
10	.35	.096	.35 x .59	.180	.68	.363
8	.41	.132	.41 x .71	.255	.82	.528
6	.49	.188	.49 x .86	.369	.97	.738
4	.55	.237	.54 x .96	.457	1.08	.916
2	.70	.283	.61 x 1.08	.578	1.21	1.146
1	.67	.352	.70 x 1.23	.756	1.38	1.49
0	.71	.396	.74 x 1.32	.859	1.47	1.70
00	.76	.454	.79 x 1.41	.980	1.57	1.94
000	.81	.515	.84 x 1.52	1.123	1.69	2.24
0000	.87	.593	.90 x 1.64	1.302	1.85	2.68
250	.98	.754	.....	.....	2.02	3.20
300	1.04	.85	.....	.....	2.15	3.62
350	1.10	.95	.....	.....	2.26	4.02
400	1.14	1.02	.....	.....	2.40	4.52
500	1.23	1.18	.....	.....	2.59	5.28

Note—No. 14 to No. 8, solid conductors; No. 6 and larger, stranded conductors.

Tables 12 to 17. Tables 12 to 17 give the nominal size of conductors and conduit or tubing recommended for use in computing size of conduit or tubing for various combinations of conductors. The dimensions represent average conditions only, and while variations will be found in dimensions of conductors and conduits of different manufacture, these variations will not affect the computation.

TABLE 12—DIMENSIONS AND PER CENT AREA OF CONDUIT AND TUBING

Areas of Conduit or Tubing for the Combinations of Wires Permitted by Table 11.

Trade Size	Internal Diameter Inches	Area—Square Inches									
			Not Lead Covered				Lead Covered				
		Total 100 %	1 Cond. 53 %	2 Cond. 31 %	3 Cond. 43 %	4 Cond. and Over 40 %	1 Cond. 55 %	2 Cond. 30 %	3 Cond. 40 %	4 Cond. 38 %	Over 4 Cond. 35 %
½	.622	.30	16	.09	.13	12	17	.09	.12	.11	.11
¾	.824	.53	28	.16	.23	21	29	.16	.21	.20	.19
1	1.049	.86	46	.27	37	34	47	.26	.34	.33	.30
1¼	1.380	1.50	.80	47	65	60	.83	.45	.60	.57	.53
1½	1.610	2.04	1.08	.63	.88	82	1 12	61	.82	.78	.71
2	2.067	3.36	1 78	1 04	1 44	1 34	1 85	1.01	1.34	1.28	1.18
2½	2.469	4.79	2 54	1 48	2.06	1.92	2.63	1.44	1.92	1.82	1.68
3	3.068	7.38	3 91	2.29	3.17	2 95	4.06	2.21	2.95	2.80	2.58
3½	3.548	9.90	5.25	3 07	4.26	3.96	5.44	2.97	3.96	3.76	3.47
4	4.026	12.72	6.74	3.94	5.47	5.09	7.00	3.82	5.09	4.83	4.45
4½	4.506	15.96	8.45	4.94	6.86	6.38	8.77	4.78	6.38	6.06	5.57
5	5.047	20.00	10.60	6.20	8.60	8.00	11.00	6.00	8 00	7.60	7.00
6	6.065	28.89	15.31	8.96	12 42	11.56	15.89	8.67	11.56	10.98	10.11

TABLE 13—DIMENSIONS OF RUBBER-COVERED AND THERMOPLASTIC COVERED CONDUCTORS

Size AWG MCM	Types RF-32, R, RH, RW		Types TF, T, TW		Type RU	
	Approx. Diam. Inches	Approx. Area Sq. Ins.	Approx. Diam. Inches	Approx. Area Sq. Ins.	Approx. Diam. Inches	Approx. Area Sq. Ins.
18	.146	.0167	.106	.0088	....	.....
16	.158	.0196	.118	.0109	....	.....
14	.171*	.0230*	.131	.0135	.146	.0167
12	.188*	.0278*	.148	.0172	.163	.0208
10	.242	.0460	.169	.0224	.184	.0266
8	.311	.0760	.228	.0408	.228	.0406
6	.397	.1238	.323	.0819	.317	.0787
4	452	1605	.372	.1087	...	.....
3	.481	.1817	.401	.1263	..	.....
2	.513	.2067	.433	.1473	....	.....
1	.588	.2715	.508	.2027	....	.....
0	.629	.3107	.549	.2367	....	....
00	.675	3578	.595	.2781	...	.....
000	.727	.4151	.647	.3288	....	.....
0000	.785	4840	.705	.3904	..	.....
250	.868	5917	.788	.4877	....	.....
300	.933	6837	.843	.5581	...	.....
350	.985	.7620	.895	.6291	....	.....
400	1.032	8365	.942	.6969	..	.....
500	1.119	.9834	1.029	.8316	....	.....
600	1.233	1.1940	1.143	1.0261	..	.....
700	1.304	1 3355	1.214	1.1575	..	.....
750	1.339	1 4082	1.249	1.2252	....	.....
800	1.372	1.4784	1.282	1.2908	...	.....
900	1.435	1.6173	1.345	1.4208	....	.....
1000	1.494	1.7531	1.404	1.5482	...	.....
1250	1.676	2.2062	1 577	1.9532	....	.....
1500	1.801	2 5475	1.702	2.2748	...	.....
1750	1.916	2 8895	1.817	2.5930	....	.....
2000	2.021	3 2079	1.922	2.9013	....	.....

*The diameters of Type RW in Nos. 14 and 12 are .204 and .221, respectively, and the areas are .0327 and .0384, respectively.

No. 18 to No. 8, solid; No. 6 and larger, stranded.

TABLE 17—DIMENSIONS OF ASBESTOS-VARNISHED-CAMBRIC INSULATED CONDUCTORS

Types AVA, AVB, and AVL

Size AWG MCM	Type AVA		Type AVB		Type AVL	
	Approx. Diam. Inches	Approx. Area Sq. In.	Approx. Diam. Inches	Approx. Area Sq. In.	Approx. Diam. Inches	Approx. Area Sq. In.
14	.245	.047	.205	.033	.320	.080
12	.265	.055	.225	.040	.340	.091
10	.285	.064	.245	.047	.360	.102
8	.310	.075	.270	.057	.390	.119
6	.395	.122	.345	.094	.430	.145
4	.445	.155	.395	.123	.480	.181
2	.505	.200	.460	.166	.570	.255
1	.585	.268	.540	.229	.620	.300
0	.625	.307	.580	.264	.660	.341
00	.670	.353	.625	.307	.705	.390
000	.720	.406	.675	.358	.755	.447
0000	.780	.478	.735	.425	.815	.521
250	.885	.616	.855	.572	.955	.715
300	.940	.692	.910	.649	1.010	.800
350	.995	.778	.965	.731	1.060	.885
400	1.040	.850	1.010	.800	1.105	.960
500	1.125	.995	1.095	.945	1.190	1.118
550	1.165	1.065	1.135	1.01	1.265	1.26
600	1.205	1.140	1.175	1.09	1.305	1.34
650	1.240	1.21	1.210	1.15	1.340	1.41
700	1.275	1.28	1.245	1.22	1.375	1.49
750	1.310	1.35	1.280	1.29	1.410	1.57
800	1.345	1.42	1.315	1.36	1.440	1.63
850	1.375	1.49	1.345	1.43	1.470	1.70
900	1.405	1.55	1.375	1.49	1.505	1.78
950	1.435	1.62	1.405	1.55	1.535	1.85
1,000	1.465	1.69	1.435	1.62	1.565	1.93

NOTE: No. 14 to No. 8, solid, No. 6 and larger, stranded; except AVL where all sizes are stranded.

TABLE 19—DIMENSIONS OF CONDUIT OR TUBING

Size	Internal Diameter Inches	Area Square Inches	Size	Internal Diameter Inches	Area Square Inches
½	.622	.30	3	3.068	7.38
¾	.824	.53	3½	3.548	9.90
1	1.049	.86	4	4.026	12.72
1¼	1.380	1.50	4½	4.506	15.95
1½	1.610	2.04	5	5.047	20.00
2	2.067	3.36	6	6.065	28.89
2½	2.469	4.79			

VARNISHED-CAMBRIC INSULATED CONDUCTORS

Type V

The insulation thickness for varnished-cambric conductors, Type V, is the same as for rubber-covered conductors, Type R, except for Nos. 14 and 12 which have 3/64-inch insulation for varnished-cambric and 2/64-inch insulation for rubber-covered conductors and for No. 8 which has 3/64-inch insulation for varnished-cambric, and 4/64-inch insulation for rubber-covered conductors. See table in section 93101. Tables 4 and 5 may, therefore, be used for the number of varnished-cambric insulated conductors in a conduit or tubing.

TABLE 18—PROPERTIES OF COPPER CONDUCTORS

Size AWG	Area Cir. Mils	Concentric Lay Stranded Conductors		Bare Conductors		D. C. Resistance Ohms/M Ft. At 25 C. 77 F.	
		No. Wires	Diam. Each Wire Inches	Diam. Inches	Area Sq. Inches	Bare Cond.	Tin'd. Cond.
18	1624	Solid	.0403	.0403	.0013	6.510	6.77
16	2583	Solid	.0508	.0508	.0020	4.094	4.25
14	4107	Solid	.0641	.0641	.0032	2.575	2.68
12	6530	Solid	.0808	.0808	.0051	1.619	1.69
10	10380	Solid	.1019	.1019	.0081	1.018	1.06
8	16510	Solid	.1285	.1285	.0130	.641	.660
6	26250	7	.0612	.184	.027	.410	.426
4	41740	7	.0772	.232	.042	.259	.269
3	52640	7	.0867	.260	.053	.205	.213
2	66370	7	.0974	.292	.067	.162	.169
1	83690	19	.0664	.332	.087	.129	.134
0	105500	19	.0745	.373	.109	.102	.106
00	133100	19	.0837	.418	.137	.0811	.0844
000	167800	19	.0940	.470	.173	.0642	.0668
0000	211600	19	.1055	.528	.219	.0509	.0524
	250000	37	.0822	.575	.260	.0431	.0444
	300000	37	.0900	.630	.312	.0360	.0371
	350000	37	.0973	.681	.364	.0308	.0318
	400000	37	.1040	.728	.416	.0270	.0278
	500000	37	.1163	.814	.520	.0216	.0235
	600000	61	.0992	.893	.626	.0180	.0185
	700000	61	.1071	.964	.730	.0154	.0159
	750000	61	.1109	.998	.782	.0144	.0148
	800000	61	.1145	1.031	.835	.0135	.0139
	900000	61	.1215	1.093	.938	.0120	.0124
	1000000	61	.1280	1.152	1.042	.0108	.0111
	1250000	91	.1172	1.289	1.305	.00864	.00890
	1500000	91	.1284	1.412	1.566	.00719	.00740
	1750000	127	.1174	1.526	1.829	.00617	.00636
	2000000	127	.1355	1.631	2.089	.00539	.00555

The values given in the table are those given in Circular 31 of the National Bureau of Standards except that those shown in the last column are those given in Specification B33 of the American Society for Testing Materials.

The resistance values given in the last two columns are applicable only to direct current. When conductors larger than No. 4/0 are used with alternating current the following multiplying factors should be used to compensate for skin effect.

TABLE 21—FULL-LOAD CURRENT*

Direct-Current Motors

HP	115V		230V		550V	
	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.
¼		4.6	2.3		1.4	
½		6.6	3.3			
1		8.6		4.3		1.8
1½		12.6	6.3		2.6	
2		16.4		8.2	3.4	
3		24.		12.	5.0	
5	40			20.		8.3
7½	58			29.	12.0	
10		76.	38		16.0	
15	112		56		23.0	
20		148	74			31.
25		184	92		38.	
30	220		110			46.
40		292	146		61	
50		360	180		76	
60		430	215		90	
75		536	268		111	
100				355		148.
125			443		184	
150				534	220	
200				712	295	

*These values for full-load current are average for all speeds.

TABLE 22—FULL-LOAD CURRENT*

Single-Phase A.C. Motors

HP	115V Prop.	230V Prop.	440V Prop.
1/8	3.2	1.6	
¼	4.6	2.3	
½	7.4	3.7	
¾	10.3	5.1	
1	13.	6.5	
1½	18.4	9.2	
2	24.	12.	
3	34.	17.	
5	56.	28.	
7½	80.	40.	21.
10	100.	50.	26.

For full-load currents of 208 and 200-volt motors, increase corresponding 230-volt motor full-load current by 10 and 15 per cent, respectively.

*These values of full-load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used.

TABLE 20—CONDUCTOR SIZES AND OVERCURRENT PROTECTION FOR MOTORS. See Tables 26 and 27, Chapter 10.

See sections 4312, 4322 and 4342. For certain exceptions to values in columns 6, 7, 8, 9 and 10, see sections 4324 and 4342. See Tables 21 to 24 for full-load current of motors. See Example No. 6, Chapter 10.

Full load current rating of motor amperes	Minimum size conductor in raceways For conductors in air or for other insulations (see tables 1 and 2) AWG and MCM Type R Type T		For Running Protection of Motors		Maximum Allowable Rating of Branch Circuit Fuses			
			Maximum rating of N.E.C. fuses	Maximum setting of time-limit protective device	With Code Letters Single-phase and squirrel cage and synchronous. Full voltage, resistor and reactor starting, Code letters F to R inc. Without Code Letters Same as above.	With Code Letters Single-phase and squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code letters B to E inc Auto-transformer starting, Code letters F to R inc. Without Code Letters Squirrel cage and synchronous, auto-transformer starting, High reactance squirrel cage.*** Both not more than 30 amperes	With Code Letters Squirrel cage and synchronous Auto-transformer starting, Code letters B to E inc. Without Code Letters Squirrel cage and synchronous, auto-transformer starting, High reactance squirrel cage.*** Both more than 30 amperes.	With Code Letters All motors. Code letter A. Without Code Letters DC and wound-rotor motors.
Col. No. 1	2	Type RH 3	Amperes 5	Amperes 6	7	8	9	10
1**	14	14	2*	1.25*	15	15	15	15
2**	14	14	3*	2.50*	15	15	15	15
3**	14	14	4*	3.75*	15	15	15	15
4**	14	14	6*	5.0 *	15	15	15	15
5**	14	14	8*	6.25*	15	15	15	15
6**	14	14	8*	7.50*	20	15	15	15
7	14	14	10*	8.75*	25	20	15	15
8	14	14	10*	10.0 *.	25	20	20	15
9	14	14	12*	11.25*	30	25	20	15
10	14	14	15*	12.50*	30	25	20	15
11	14	14	15*	13.75*	35	30	25	20
12	14	14	15	15.00	40	30	25	20
13	12	12	20	16.25	40	35	30	20
14	12	12	20	17.50	45	35	30	25
15	12	12	20	18.75	45	40	30	25
16	12	12	20	20.00	50	40	35	25
17	10	10	25	21.25	60	45	35	30
18	10	10	25	22.50	60	45	40	30
19	10	10	25	23.75	60	50	40	30
20	10	10	25	25.0)	60	50	40	30
22	10	10	30	27.50	70	60	45	35
24	10	10	30	30.00	90	60	50	40
26	8	10	35	32.50	80	70	60	40
28	8	10	35	35.00	90	70	60	45
30	8	8	40	37.50	90	70	60	45
32	8	8	40	40.00	100	80	70	50
34	6	8	45	42.50	110	90	70	60
36	6	8	45	45.00	110	90	80	60
38	6	6	50	47.50	125	100	80	60
40	6	6	50	50.00	125	100	80	60
42	6	6	50	52.50	125	110	90	70
44	6	6	60	55.0	125	110	90	70
46	4	6	60	57.50	150	125	100	70
48	4	6	60	60.0	150	125	100	80
50	4	6	60	62.50	150	125	100	80
52	4	6	70	65.0	175	150	110	80
54	4	4	70	67.50	175	150	110	90
56	4	4	70	70.00	175	150	120	90
58	3	4	70	72.50	175	150	120	90
60	3	4	80	75.00	200	150	120	90
62	3	4	80	77.50	200	175	125	100
64	3	4	80	80.00	200	175	150	100
66	2	4	80	82.50	200	175	150	100
68	2	4	90	85.00	225	175	150	110
70	2	3	90	87.50	225	175	150	110
72	2	3	90	90.20	225	200	150	110
74	2	3	90	92.50	225	200	150	125
76	2	3	100	95.00	250	200	175	125
78	1	3	100	97.50	250	200	175	125
80	1	3	100	100.00	250	200	175	125
82	1	2	110	102.50	250	225	175	125
84	1	2	110	105.00	250	225	175	150
86	1	2	110	107.50	300	225	175	150
88	1	2	110	110.00	300	225	200	150
90	0	2	110	112.50	300	225	200	150
92	0	2	125	115.00	300	250	200	150
94	0	1	125	117.50	300	250	200	150
96	0	1	125	120.00	300	250	200	150
98	0	1	125	122.50	300	250	200	150
100	0	1	125	125.00	300	250	200	150
105	00	1	150	131.5	350	300	225	175
110	00	0	150	137.5	350	300	225	175
115	00	0	150	144.0	350	300	250	175
120	000	0	150	150.0	400	300	250	200
125	000	00	175	156.5	400	350	250	200
130	000	00	175	162.5	400	350	300	200
135	0000	00	175	169.0	450	350	300	225
140	0000	00	175	175.0	450	350	300	225
145	0000	000	200	181.5	450	400	300	225
150	0000	000	200	187.5	450	400	300	225
155	0000	000	200	194.0	500	400	350	250
160	250	000	200	200.0	500	400	350	250
165	250	0000	225	206.	500	450	350	250
170	350	0000	225	213.	500	450	350	300
175	300	0000	225	219.	600	450	350	300
180	300	0000	225	225.	600	450	400	300
185	300	0000	250	231.	600	500	400	300
190	300	250	250	238.	600	500	400	300
195	350	250	250	244.	600	500	400	300
200	350	250	250	250.	600	500	400	300
210	400	300	250	263.	...	600	450	350
220	400	300	300	275.	...	600	450	350
230	500	300	300	288.	...	600	500	350
240	500	350	300	300.	...	600	500	400
250	500	350	300	313.	...	...	600	400
260	600	400	350	325.	...	...	600	400
270	600	400	350	338.	...	...	600	450
280	600	500	350	350.	...	...	600	450
290	700	500	350	363.	...	...	600	450
300	700	500	400	375.	...	...	600	450
330	750	600	400	400.	...	...	...	500
340	900	600	450	425	...	...	...	600
360	1000	700	450	450.	...	...	...	600
380	1250	750	500	475.	...	...	...	600
400	1500	900	500	500.	...	...	...	600
420	1750	1000	600	525.	...	...	...	...
440	2000	1250	600	550.	...	...	...	...
460	....	1250	600	575.	...	...	...	...
480	....	1500	600	600.	...	...	...	...
500	....	1500	...	625.	...	...	...	...

* For running protection of motors of 1 horsepower or less, see section 4322.

** For the grouping of small motors under the protection of a single set of fuses, see section 4343.

*** High-reactance squirrel-cage motors are those designed to limit the starting current by means of deep-slot secondaries or double-wound secondaries and are generally started on full voltage.

TABLE 23—FULL-LOAD CURRENT*
Two-Phase A.C. Motors (4-wire)

	Induction Type Squirrel-Cage and Wound Rotor Amperes										Synchronous Type †Unity Power Factor Amperes			
HP	110V		220V		440V		550V		2300V		220V	440V	550V	2300V
	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.				
½	..	4	..	2	..	1	..	.8	..	..	..	..	..	..
¾	..	4.8	2.4	..	1.2	..	1.0	..	..	..	..	..	..	..
1	..	6.4	..	3.2	..	1.6	..	1.3	..	..	..	..	..	..
1½	..	8.8	..	4.4	..	2.2	..	1.8	..	..	..	..	..	..
2	..	11.2	..	5.6	..	2.8	..	2.2	..	..	..	..	..	..
3	..	..	8	..	4	..	..	3.2	..	..	..	..	..	..
5	..	..	13	..	7	..	6	..	..	..	..	..	..	..
7½	..	..	19	..	9	..	..	8	..	..	..	..	..	..
10	..	..	24	..	12	..	10	..	..	..	..	..	..	..
15	..	..	..	34	..	17	..	14	..	..	..	..	..	..
20	..	..	45	..	23	..	..	18	..	..	..	..	..	..
25	..	..	55	..	28	..	22	..	6	..	47	24	19	4.7
30	..	..	67	..	34	..	27	..	..	7.5	56	29	23	5.7
40	..	..	88	..	44	..	35	..	..	9	75	37	31	7.
50	..	..	108	..	54	..	43	..	..	11	94	47	38	9.
60	..	..	129	..	65	..	52	..	..	13	111	56	44	11
75	..	..	..	158	..	79	..	63	..	16	140	70	57	13
100	..	..	212	..	106	..	85	..	21	..	182	93	74	17
125	..	..	268	..	134	..	108	..	26	..	228	114	93	22
150	..	..	311	..	155	..	124	..	31	..	..	137	110	26
200	..	..	415	..	208	..	166	..	41	..	..	182	145	35

*These values of full-load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used. Current in common conductor of 2-phase, 3-wire system will be 1.41 times value given.

†For 90 and 80 per cent P. F. the above figures should be multiplied by 1.1 and 1.25 respectively.

TABLE 24—FULL-LOAD CURRENT*
Three-Phase A.C. Motors

	Induction Type Squirrel-Cage and Wound Rotor Amperes										Synchronous Type †Unity Power Factor Amperes			
HP	110V		220V		440V		550V		2300V					
	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.	Pres.	Prop.	220V	440V	550V	2300V
½	..	4	..	2	..	1	..	.8	..	..	..	..	..	..
¾	..	5.6	2.8	..	1.4	..	1.1	..	..	..	..	..	..	..
1	..	7	..	3.5	..	1.8	..	1.4	..	..	..	..	..	..
1½	..	10	..	5	..	2.5	2.0	..	..	..	..	..	..	..
2	..	13	..	6.5	..	3.3	..	2.6	..	..	..	..	..	..
3	..	..	9	..	4.5	..	4	..	..	..	..	..	..	..
5	..	..	15	..	7.5	..	6	..	..	..	..	..	..	..
7½	..	..	22	..	11	..	9	..	..	..	..	..	..	..
10	..	..	27	..	14	..	11	..	..	..	..	..	..	..
15	..	..	..	40	..	20	..	16	..	..	..	..	..	..
20	..	..	52	..	26	..	21	..	..	..	..	..	..	..
25	..	..	64	..	32	..	26	..	7	..	54	27	22	5.4
30	..	..	..	78	39	..	31	..	..	8.5	65	33	26	6.5
40	..	..	..	104	..	52	..	41	..	10.5	86	43	35	8
50	..	..	125	..	63	..	50	..	..	13	108	54	44	10
60	..	..	..	150	75	..	60	..	..	16	128	64	51	12
75	..	..	..	185	..	93	..	74	..	19	161	81	65	15
100	..	..	246	..	123	..	98	..	..	25	211	106	85	20
125	..	..	310	..	155	..	124	..	31	..	264	132	106	25
150	..	..	360	..	180	..	144	..	..	37	..	158	127	30
200	..	..	480	..	240	..	..	192	49	48	..	210	168	40

For full-load currents of 208 and 200 volt motors, increase the corresponding 220-volt motor full-load current by 6 and 10 per cent, respectively.

*These values of full load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used.

†For 90 and 80 per cent P. F. the above figures should be multiplied by 1.1 and 1.25 respectively.

TABLE 26—MAXIMUM RATING OR SETTING OF MOTOR-BRANCH-CIRCUIT PROTECTIVE DEVICES FOR MOTORS MARKED WITH A CODE LETTER INDICATING LOCKED ROTOR KVA

Type of Motor	Per Cent of Full-Load Current: Fuse Rating (See also Table 20, Columns 7, 8, 9, 10)	Circuit-Breaker Setting: Instantaneous Type	Circuit-Breaker Setting: Time Limit Type
All AC single-phase and polyphase squirrel cage and synchronous motors with full-voltage, resistor or reactor starting:			
Code Letter A	150	.....	150
Code Letter B to E	250	.....	200
Code Letter F to R	300	.....	250
All AC squirrel cage and synchronous motors with auto-transformer starting:			
Code Letter A	150	.....	150
Code Letter B to E	200	.....	200
Code Letter F to R	250	.....	200

For certain exceptions to the values specified see sections 4324 and 4342. The values given in the last column also cover the ratings of non-adjustable, time-limit types of circuit-breakers which may also be modified as in section 4342.

Synchronous motors of the low-torque, low-speed type (usually 450 RPM or lower), such as are used to drive reciprocating compressors, pumps, etc., which start up unloaded, do not require a fuse rating or circuit-breaker setting in excess of 200 per cent of full-load current.

For motors not marked with a Code Letter, see Table 27.

TABLE 27—MAXIMUM RATING OR SETTING OF MOTOR-BRANCH-CIRCUIT PROTECTIVE DEVICES FOR MOTORS NOT MARKED WITH A CODE LETTER INDICATING LOCKED ROTOR KVA

Type of Motor	Per Cent of Full Load Current: Fuse Rating (See also Table 20, Columns 7, 8, 9, 10)	Circuit-Breaker Setting: Instantaneous Type	Circuit-Breaker Setting: Time Limit Type
Single-phase, all types	300	.....	250
Squirrel-cage and synchronous (full-voltage, resistor and reactor starting)	300	.....	250
Squirrel-cage and synchronous (auto-transformer starting)			
Not more than 30 amperes	250	.....	200
More than 30 amperes	200	.....	200
High-reactance squirrel-cage			
Not more than 30 amperes	250	.....	250
More than 30 amperes	200	.....	200
Wound-rotor	150	.....	150
Direct-current			
Not more than 50 H.P.	150	250	150
More than 50 H.P.	150	175	150

For certain exceptions to the values specified see sections 4324 and 4342. The values given in the last column also cover the ratings of non-adjustable, time-limit types of circuit-breakers which may also be modified as in section 4342.

Synchronous motors of the low-torque low-speed type (usually 450 R.P.M. or lower) such as are used to drive reciprocating compressors, pumps, etc., which start up unloaded, do not require a fuse rating or circuit-breaker setting in excess of 200 per cent of full-load current.

For motors marked with a Code Letter, see Table 26.

TABLE 28—NUMBER OF OVERCURRENT UNITS, SUCH AS TRIP COILS OR RELAYS, FOR PROTECTION OF CIRCUITS

(See Diagrams 1 to 19)

(See Section 2405 for the overcurrent protection of conductors in general, section 2371 for Services and section 4327 for Motors).

SYSTEMS	*Number and Location of Overcurrent Units.
2-Wire, Single-phase A.C. or D.C. Ungrounded.	Two (one in each conductor. Fig. 1).
2-Wire, Single-phase A.C. or D.C., One Wire Grounded.	One in ungrounded conductor. Fig. 2).
2-Wire, Single-phase A.C. or D.C., Mid-point Grounded.	Two (one in each conductor. Fig. 3).
2-Wire, Single-phase A.C. Derived from 3-Phase, with Ungrounded Neutral.	Two (one in each conductor Fig. 4)..
2-Wire, Single-phase Derived from 3-Phase, Grounded Neutral System by Using outside Wires of 3-Phase Circuit.	Two (one in each conductor. Fig. 5).
3-Wire, Single-phase A.C. or D.C. Ungrounded Neutral.	Three (one in each conductor. Fig. 6).
3-Wire, Single-Phase A.C., or D.C. Grounded Neutral.	Two (one in each conductor except neutral conductor Fig. 7).
3-Wire, 2-Phase, A.C., Common Wire Ungrounded.	Three (one in each conductor. Fig. 8).
3-Wire, 2-Phase, A.C., Common Wire Grounded.	Two (one in each conductor except common conductor Fig. 9).
4-Wire, 2-Phase, Ungrounded, Phases Separate.	Four (one in each conductor. Fig. 10).
4-Wire, 2-Phase, Grounded Neutral, or 5-Wire, 2-Phase, Grounded Neutral.	Four (one in each conductor except neutral conductor. Figs. 11 and 12).
3-Wire, 3-Phase, Ungrounded.	Three (one in each conductor. Fig. **13).
3-Wire, 3-Phase, 1 Wire Grounded.	Two (one in each ungrounded conductor. Fig. 14).
3-Wire, 3-Phase, Grounded Neutral.	Three (one in each conductor. Fig. **15).
3-Wire, 3-Phase, Mid-point of one phase grounded	Three (one in each conductor. Fig. **17).
4-Wire, 3-Phase, Grounded Neutral.	Three (one in each ungrounded conductor. Fig. **18).
4-Wire, 3-Phase, Ungrounded Neutral.	Four (one in each conductor). Fig. 19).

*1. An overcurrent unit may consist of a series overcurrent tripping device or the combination of a current transformer and a secondary overcurrent tripping device. Either two or three secondary overcurrent tripping devices may be used with three current transformers on a 3-phase system similar to those shown in Figures 15 and 18.

**2. When three current transformers are used instead of three series overcurrent tripping devices shown in Figures 13, 15, 17 and 18, the secondary tripping devices may consist of three secondary overcurrent tripping devices or two secondary overcurrent tripping devices with a residual current tripping device of a lower range. See Figure 16.

3. Where standard devices are not available with three or four overcurrent units as required in the table, it is permissible to substitute two overcurrent units and one fuse where three overcurrent units are called for, two overcurrent units and two fuses where four overcurrent units are called for. The fuse or fuses are to be placed in the conductors not containing an overcurrent unit. This practice, however, of substituting fuses for overcurrent units is to be discouraged for obvious reasons.

TABLE 30. CAPACITOR RATINGS FOR USE WITH OPEN-TYPE THREE-PHASE SIXTY CYCLE INDUCTION MOTORS

See section 4606.

Motor Rating HP	3600 RPM*		1800 RPM*		1200 RPM*		900 RPM*		720 RPM*		600 RPM*	
	Max. Capacitor Rating Kva	Reduction in Line Current %	Max. Capacitor Rating Kva	Reduction in Line Current %	Max. Capacitor Rating Kva	Reduction in Line Current %	Max. Capacitor Rating Kva	Reduction in Line Current %	Max. Capacitor Rating Kva	Reduction in Line Current %	Max. Capacitor Rating Kva	Reduction in Line Current %
10	2.5	9	4.	11	4.	12	5.	17	5.	23	7.5	28
15	2.5	9	5.	11	5.	11	7.5	16	7.5	21	10.	26
20	5.	9	5.	10	5.	11	7.5	15	10.	20	12.5	24
25	5.	9	7.5	10	7.5	10	10.	14	10.	19	15.	22
30	7.5	9	10.	9	10.	10	10.	13	12.5	18	15.	21
40	10.	9	10.	9	10.	10	12.5	12	15.	16	17.5	19
50	12.5	9	12.5	9	12.5	9	15.	12	20.	15	22.5	17
60	15.	9	15.	8	15.	9	17.5	11	22.5	14	25.	16
75	17.5	9	17.5	8	17.5	8	20.	11	27.5	13	30.	15
100	22.5	9	22.5	8	22.5	8	25.	10	35.	12	37.5	14
125	25.	9	27.5	8	27.5	8	30.	9	40.	11	47.5	13
150	32.5	9	35.	8	35.	8	37.5	9	47.5	11	55.	13
200	42.5	9	42.5	8	42.5	8	45.	9	60.	10	67.5	12

*Synchronous speed.

If capacitors of a lower rating than the values given in the table are used, the percentage reduction in line current given in the table shall be reduced a corresponding amount.

TABLE 29—DEMAND LOADS FOR HOUSEHOLD ELECTRIC RANGES AND OTHER COOKING APPLIANCES OVER 1¾ kw RATING.

Column A to be used in all cases except as otherwise permitted in Note 3 below.

NUMBER OF RANGES	Maximum Demand (See Notes)	Demand Factors (See Note 3)	
	COLUMN A (Not over 12 kw Rating)	COLUMN B (Less than 3½ kw Rating)	COLUMN C (3½ kw to 8¾ kw Rating)
1	8 kw	80%	80%
2	11 kw	75%	65%
3	14 kw	70%	55%
4	17 kw	66%	50%
5	20 kw	62%	45%
6	21 kw	59%	43%
7	22 kw	56%	40%
8	23 kw	53%	36%
9	24 kw	51%	35%
10	25 kw	49%	34%
11	26 kw	47%	32%
12	27 kw	45%	32%
13	28 kw	43%	32%
14	29 kw	41%	32%
15	30 kw	40%	32%
16	31 kw	39%	28%
17	32 kw	38%	28%
18	33 kw	37%	28%
19	34 kw	36%	28%
20	35 kw	35%	28%
21	36 kw	34%	26%
22	37 kw	33%	26%
23	38 kw	32%	26%
24	39 kw	31%	26%
25	40 kw	30%	26%
26-30	15 kw plus 1 kw	30%	24%
31-40	for each range	30%	22%
41-50	25 kw plus ¾	30%	20%
51-60	kw for each	30%	18%
61 & over	range	30%	16%

Note 1. Over 12 kw to 21 kw Ranges. For ranges individually rated more than 12 kw but not more than 21 kw, five per cent shall be added to the above maximum demand (Column A) for each additional kw of rating or major fraction thereof by which the individual range rating exceeds 12 kw.

Note 2. Over 21 kw Ranges. Ranges individually rated more than 21 kw are not considered as household electric ranges and the demand should be determined on the basis of rating and use. Generally, the demand for commercial ranges should be based on the maximum nameplate rating.

TABLE 32—ISOLATION BY ELEVATION

(See section 7162)

Distance of Live Parts Above the Floor or Other Working Surface

Voltage Between Phases	Minimum Vertical Clearance of Unguarded Parts Feet	Inches
600	8	0
2300	8	0
6600	8	0
11000	9	0
22000	9	3
33000	9	6
44000	9	10
66000	10	5
88000	11	0
110000	11	7
132000	12	2

TABLE 33—WORKING SPACE

(See section 7163. For voltages below 600, see section 1112.)

Minimum Clear Space Adjacent to Live Parts

Voltage Between Phases	Minimum Horizontal Clearance of Unguarded Parts Feet	Inches
600	3	2
2300	3	3
6600	3	4
11000	3	6
22000	3	9
33000	4	0
44000	4	4
66000	4	11
88000	5	6
110000	6	1
132000	6	8

CODE REVISIONS

The 1946 Revision of the National Electrical Code involves a great many changes in detail. The following excerpts from the new code are selected sections which include the more important changes.

Art. 2113—Industrial Lighting Voltage

Branch circuits up to 300 volts o.k. provided fixtures 8 feet from floor, etc.

"**2113. Voltage.** Branch circuits supplying lampholders, fixtures, or receptacles of the standard 15-ampere or less rating shall not exceed 150 volts to ground, except (1) in industrial establishments with branch circuits supplying lighting fixtures only that are equipped either with mogul-base screw-shell lampholders or with lampholders of other types approved for the application, mounted not less than 8 feet from the floor, which do not have switch control as an integral part of the fixture, and if the branch circuit shall not exceed 300 volts to ground; (2) in railway properties as described in section 1111; (3) for infra-red industrial heating appliances as described in section 4237. In dwelling occupancies, the voltage between conductors supplying lampholders of the screw-shell type, receptacles, or appliances, shall not exceed 150 volts, except that the voltage between conductors supplying only permanently connected appliances or portable appliances of more than 1,650 watts may exceed 150 volts."

Art. 2116 c2—Show Window Allowances

200 watts per linear foot still required in feeders, but optional in branches.

"**2. Show-Window Lighting.** For show-window lighting a load of not less than 200 watts for each linear foot of show-window, measured horizontally along its base may be allowed in lieu of the specified load per outlet."

Art. 2124 b—Laundry Receptacle

To be three wire type designed for grounding.

"**b. Dwelling Type Occupancies.** In every kitchen, dining room, breakfast room, living room, parlor, library, den, sun room, recreation room and bedroom, one receptacle outlet shall be provided for every 20 linear feet or major fraction thereof of the total (gross) distance around the room as measured horizontally along the wall at the floor line. The receptacle outlets shall, insofar as practicable, be spaced equal distances apart. At least one receptacle outlet shall be installed for the connection of laundry appliances. This receptacle shall be of a 3-pole type designed for grounding. Receptacle outlets in floor shall not be counted as part of the required number of receptacle outlets unless located close to the wall."

Art. 2127—Reclassification of Branch Circuit

The new 30 amp. circuit using new No. 10 wire takes the place of the old 25 and 35 amp. circuits.

"**2127. Table of Requirements.** The requirements for circuits having two or more outlets (other than the receptacle circuits of paragraph b of section 2115) as specifically provided for above are summarized in the following table:

Branch Circuit Requirements

(Type R, RH, RW, RO, T, and TW conductors in raceway or cable)

CIRCUIT RATING	15 Amp.	20 Amp.	30 Amp.	50 Amp.
CONDUCTORS: (Min. Size)				
Circuit Wires	14	12	10	6
Taps	14	14	14	12
Fixture Wires and cords*				
OVERCURRENT PROTECTION	15 Amp.	20 Amp.	30 Amp.	50 Amp.
OUTLET DEVICES:				
Lampholders Permitted	Any Type	Heavy Duty†	Heavy Duty	Heavy Duty
Receptacle Rating	Max. 15 Amp.	20 Amp.‡	20 or 30 Amp.	50 Amp.
MAXIMUM LOAD	10 Amp.	20 Amp.	30 Amp.	50 Amp.
PERMISSIBLE LOAD	Sec. 2126 a	Sec. 2126 a	Sec. 2126 b	Sec. 2126 c

*See Section 2121-c-3.
†See Section 2123-c-2.
‡See Section 2123-c-3.

Art. 2203 e—Feeders to Appliances

Diversity factor of 75 percent may be applied to residential feeder to four or more appliances.

"**e. Fixed Appliances (Other than Ranges).** Where four or more fixed appliances in addition to an electric range or ranges, are connected to the same feeder in a single or multi-family dwelling, a demand factor of 75 percent may be applied to the fixed appliance load, not including the electric ranges."

Art. 2358—Service Connections

Solderless lugs required for service work.

"**2358. Connection to Terminals.** The service conductors shall be attached to the disconnecting means by pressure connectors, clamps or other approved means, except that connections which depend upon solder shall not be used."

Art. 2405—Circuit Breakers

To have trip unit in each ungrounded leg. (Has been o.k. to use two over-current units on three wire, three phase. Hereafter three such units required in such a three wire, three phase circuit.)

"**2405. Ungrounded Conductors.** An overcurrent device (fuse or overcurrent trip unit of a circuit-breaker) shall be placed in each ungrounded conductor. Circuit breakers shall open all ungrounded conductors of the circuit. The number and position of the overcurrent units such as trip coils of relays shall be as given in Table 28, Chapter 10."

Art. 2440—Switches Required Ahead of Fuses

With cartridge fuses, switch required for each circuit.

"**2440. Disconnection of Fuses and Thermal Cutouts Before Handling.** Disconnecting means shall be provided on the supply side of all fuses or thermal cutouts in circuits of more than 150 volts to ground and cartridge fuses in circuits of any voltage, if accessible to other than qualified persons, so that each individual circuit containing fuses or thermal cutouts can be independently disconnected from the source of electrical energy, except as provided in section 2352 and except that a single disconnecting means may be used to control a group of circuits each protected by fuses or thermal cutouts under the conditions described in section 4410."

Art. 2452—S Fuse

Plug fuseholder installations will have to comply with Type S fuse requirements in many territories.

Plug fuseholder installations will have to comply with "S" fuse requirements *in many territories.*,

However in view of N.F.P.A. action in withholding mandatory rule, the type "S" fuseholder will be applied differently in different localities. Not all places will require the "S" type.

"**2452. Holders for Plug Fuses.** Holders for plug fuses of 30 amperes or less shall not be installed unless they comply with section 2453 or are made to comply with section 2453 by the insertion of an adapter."

"**2453. Plug Fuses and Fuseholders of Type S.** Where Type S plug fuses are to be used as the overcurrent device required by this code, the fuses and fuseholders shall conform to the following requirements."

Art. 2524—Grounding of Master Services

Additional grounding connections to the neutral will be required in outbuildings utilizing more than one branch circuit.

"**2524. Two or More Buildings Served by a Single Service.** If more than one building is served by the same service, the grounded circuit conductor of the wiring system of any building utilizing one branch circuit supplied from such service may be connected to a grounding electrode at such building, and in the case of any building utilizing two or more branch circuits supplied from such service, and in the case of a building housing live stock shall be so connected."

Art. 3487—Threading of Tubing

Use of fittings which cut threads on E.M.T. now approved.

"**3487. Threads.** Tubing shall not be coupled together nor connected to boxes, fittings, or cabinets by means of threads in the wall of the tubing, except by fittings approved for the purpose. Threads shall not be of the standard pipe thread dimensions."

Art. 3732—Cabinets to Cutout Boxes

To be mounted at least ½ inch out from wet walls.

"**3732. Damp or Wet Locations.** In damp or wet locations, cabinets and cutout boxes of the surface type shall be so placed or equipped as to prevent moisture or water from entering and accumulating within the cabinet or cutout box, and shall be mounted so there is at least one half inch air space between the enclosure and the wall or other supporting surface. Cabinets or cutout boxes installed in wet locations shall be weatherproof."

Art. 3851—Switchboard Types

Live front switchboard restricted to dry locations accessible only to qualified persons.

"**3851. Location of Switchboards.** Switchboards which have any exposed live parts shall be located in permanently dry locations and then only where under competent supervision and accessible only to qualified persons."

Art. 3901—Wiring in Prefabs

Building to comply with N.E. Code

"Article 390—PREFABRICATED BUILDINGS

3901. Scope. The intent and purpose of the following sections is to define approved methods for the wiring of prefabricated building sections, panels, or units designed for later erection or assembly as integral parts of buildings whether wired in the process of manufacture or at the site of erection or assembly."

Art. 410—Fixtures

Entirely rewritten.
Includes incandescent rules, fluorescent rules, cold cathode rules, mercury rules and arc lamp rules.

"ARTICLE 410 LIGHTING FIXTURES, LAMPHOLDERS, LAMPS, RECEPTACLES AND ROSETTES"

General

"**4101. Scope.** Lighting fixtures, lampholders, pendants, receptacles, and rosettes, incandescent filament lamps, arc lamps, electric discharge lamps, the wiring and equipment forming part of such lamps, fixtures and lighting installations shall conform to sections 4102 to 4216 inclusive, except as otherwise provided in this code.

"**4102. Application to Other Articles.** Equipment for use in hazardous locations shall conform to Article 500.

"**4103. Live Parts.** Fixtures, lampholders, lamps, rosettes and receptacles, shall have no live parts normally exposed to contact, except in the case of cleat-type lampholders, receptacles and rosettes which are located at least 8 feet above the floor. Lamp-

holders, receptacles and switches which have exposed accessible terminals shall not be installed in metal fixture canopies or in open bases of portable table or floor lamps.

Provisions For Fixture Locations

"4111. Fixtures in Damp, Wet or Corrosive Locations. Fixtures installed in damp or wet locations shall be of vaportight or other types approved for such locations and shall be so constructed or installed that water cannot enter or accumulate in wireways, lampholders or other electrical parts. Fixtures installed in corrosive locations shall be of a type approved for such locations.

"4112. Fixtures near Combustible Material. Fixtures shall be so constructed, installed, equipped with shades or guards that combustible material will not be subjected to temperatures in excess of 90C (194F).

"4113. Fixtures over Combustible Material. Lampholders installed over specially combustible material shall be of the unswitched type and unless individual switches are provided, shall be located at least 8 feet above the floor, or shall be otherwise so located or guarded that the lamps cannot be readily removed or damaged.

"4114. Fixtures in Show-Windows. No externally-wired fixture other than of the chain type shall be used in a show-window. For use of cords in show-windows, see section 4005.

"4115. Fixtures in Clothes Closets. Fixtures in clothes closets shall be installed on the ceiling or on the wall above the door. Pendants shall not be installed in clothes closets.

Provisions at Fixture Outlet Boxes, Canopies and Pans

"4121. Space for Conductors. Canopies and outlet boxes taken together shall provide adequate space so that fixture conductors and their connecting devices may be properly installed.

"4122. Temperature Limit of Conductors in Outlet Boxes. Fixtures shall be of such construction or so installed that the conductors in outlet boxes will not be subjected to temperatures greater than that for which the conductors are approved.

"4123. Outlet Boxes to be Covered. In a completed installation, each outlet box shall be provided with a cover unless covered by means of a fixture canopy, lampholder, receptacle, rosette, or similar device.

"4124. Covering of Combustible Material at Outlet Boxes. Any combustible wall or ceiling finish exposed between the edge of a fixture canopy or pan and an outlet box shall be covered with non-combustible material.

Fixture Supports

"4131. Supports—General. Fixtures, lampholders, rosettes and receptacles shall be securely supported. A fixture which weighs more than 6 lbs. or exceeds 16 inches in any dimension shall not be supported by the screw shell of a lampholder.

"4132. Means of Support. Where there is an outlet box, a gas pipe, or a fitting which will provide adequate support, a fixture shall be attached thereto; otherwise a fixture shall be supported as required by section 3707. A fixture which weighs more than 50 lbs. shall be supported independently of the outlet box. In general, fluorescent fixtures when supported independently of the outlet box shall be connected through metal raceways or armored conductors. This requirement may be waived where cord-equipped fixtures are suspended directly below the outlet box and the exposed cord is not subject to strain or mechanical injury.

Wiring of Fixtures

"4141. Fixture Wiring—General. Wiring on or within fixtures shall be neatly arranged and not exposed to mechanical injury. Excess wiring shall be avoided. Conductors shall be so arranged that they will not be subjected to temperatures above those for which they are approved.

"4142. Conductor Size. Fixture conductors shall not be smaller than No. 18.

"4143. Conductor Insulation. Fixtures shall be wired with conductors having insulation suitable for the current, voltage, and temperature to which the conductors will be subjected. Where fixtures are installed in damp, wet, or corrosive locations, conductors shall be of a type approved for such locations. For current carrying capacity of fixture wire, see Table 3, Chapter 10. For maximum operating temperature and voltage limitation of fixture wires, see paragraph e of section 93101.

"4144. Conductors for Special Conditions. Fixtures provided with mogul base screw-shell lampholders and operating at not more than 300 volts between conductors shall be wired with Type AF fixture wire. Fixtures provided with other than mogul base screw-shell lampholders and operating at not more than 300 volts between conductors shall be wired with Type AF fixture wire or Type AFC, AFPO, or AFPD flexible cord; except that where temperatures do not exceed 90C (194F). Type CF fixture wire or Type CFC, CFPD, or CFPO flexible cord may be used, where temperatures do not exceed 60C (140) Type T thermoplastic wire and Type TF and TFF fixture wire may be used, and where temperatures do not exceed 50C (122F) Type R rubber-covered wire, Type RF-64, RF-32, FF-64, and FF-32 fixture wire may be used, including use in fixtures of decorative type on which lamps of not over 60 watt rating are used in connection with imitation candles.

"4145. Conductors for Movable Parts. Stranded conductors shall be used on chain fixtures and other movable parts. Conductors shall be so arranged that the weight of the fixture or movable parts will not put a tension on the conductors.

"4146. Pendent Conductors for Incandescent Filament Lamps. Pendent lampholders with permanently attached leads, if used in other than festoon wiring, shall be hung from separate stranded rubber-covered conductors which are soldered directly to the circuit conductors but supported independently thereof. Such pendent conductors shall be not smaller than No. 14 for heavy-duty or medium-base screw-shell lampholders, nor, except for approved Christmas tree and decorative lighting outfits, smaller than No. 18 for intermediate- or candelabra-base lampholders. If the pendent conductors are longer than 3 feet, they shall be twisted together.

"4147. Protection of Conductors. Conductors shall be secured in a manner that will not tend to cut or abrade the insulation. Conductors shall be protected from abrasion where they pass through metal. Exposed flexible cord or fixture wire shall not be used to supply permanently installed fixtures in show cases or wall cases.

"4148. Conductor Protection at Lampholders. Where a metal lampholder is attached to a flexible cord, the inlet shall be equipped with an insulation bushing which, if threaded, shall not be smaller than nominal 3/8 inch pipe size. The edges of the bushing shall be rounded and all inside fins removed in order to provide a smooth bearing surface for the conductors.

Bushings having holes 9/32 inch in diameter are suitable for use with plain pendent cord and holes 13/32 inch in diameter with reinforced cord.

"4149. Connections, Splices and Taps. Fixtures shall be so installed that the connections between the fixture conductors and the circuit conductors may be inspected without requiring he disconnection of any part of the wiring, unless the fixture is connected by means of a plug and receptacle. Splices and taps shall not be located within fixture arms or stems. No unnecessary splices or taps shall be made within or on a fixture. For approved means of making connections, see section 1118.

Provision for wiring of troffler type fixtures limited to single branch circuit.

"4150. Fixture Raceways. Fixtures shall not be used as a raceway for circuit conductors unless the fixtures meet the requirements of approved raceways, except that the conductors of a single branch circuit may be carried through an installation of fixtures approved for end to end assembly to form a continuous raceway.

"4151. Polarization of Fixtures. Fixtures shall be so wired that the screw-shells of lampholders will be connected to the same fixture or circuit conductor or terminal. For polarity identification of conductors to screw-shells of lampholders, see section 2004.

Lampholders

"4156. Lampholders, Screw-Shell Type. Lampholders of the screw-shell type shall be installed for use as lampholders only.

"4157. Double-Pole Switched Lampholders. Where used on unidentified 2-wire circuits tapped from the ungrounded conductors of multi-wire circuits, the switching device of lampholders of the switched type shall simultaneously disconnect both conductors of the circuit. See section 2007.

"4158. Lampholders in Damp or Wet Locations. Lampholders

installed in damp or wet locations shall be of the weatherproof type.

Receptacles

"4161. Rating and Type. Receptacles installed for the attachment of portable cords shall be rated at not less than 15 amperes, 125 volts, or 10 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

"4162. Receptacles in Floors. Receptacles located in floors shall be enclosed in floor boxes especially approved for the purpose, except where such receptacles are located in elevated floors of show windows or other locations where the authority enforcing this code judges them to be free from mechanical injury, moisture and dirt, the standard approved type of flush receptacle box may be used.

"4163. Receptacles in Damp or Wet Locations. Receptacles installed in damp or wet locations shall be of the weatherproof type.

Rosettes

"4165. Approved Types. Fusible rosettes shall not be installed. Separable rosettes which make possible a change in polarity shall not be used. For construction specifications see section 94104.

"4166. Rosettes in Damp or Wet Locations. Rosettes installed in such locations shall be of the weather-proof type.

Construction

"4171. Combustible Shades and Enclosures. Adequate air space shall be provided between lamps and shades or other enclosures of combustible material.

"4172. Portable Handlamps. Handlamps of the portable type supplied through flexible cords shall be of the molded composition or other type approved for the purpose. Brass-shell paper-lined lampholders shall not be used. Handlamps shall be equipped with a handle. Where subject to mechanical damage or where lamps may come in contact with combustible material, handlamps shall be equipped with a substantial guard attached to the lampholder or the handle.

For Garages see section 5108.

Fluorescent fixtures to be marked in amperes.

"4173. Marking. All fixtures requiring ballasts or transformers shall be plainly marked with their electrical rating and the manufacturers name, trade-mark or other suitable means of identification. The electrical rating shall include the voltage, frequency, and shall indicate the current rating of the unit including the ballast, transformer or auto-transformer.

Special Provisions for Flush and Recessed Fixtures

"4176. Approved Type. Fixtures which are installed in recessed cavities in walls or ceilings shall be of an approved type and shall conform to sections 4177 to 4180 inclusive.

"4177. Temperature. Fixtures shall be so constructed or installed that adjacent combustible material will not be subjected to temperatures in excess of 90C (194F). Where a fixture is recessed in fire-resistant material in a building of fire-resistant construction, a temperature higher than 90C (194F). but not higher than 150C (302F) is acceptable if the fixture is plainly marked that it is approved for that service.

"4178. Clearance. Recessed portions of enclosures, other than at points of support, shall be spaced at least 1/2 inch from combustible material.

"4179. Wiring. Conductors having insulation suitable for the temperature encountered shall be used. Where conductor temperatures are in excess of 60C (140F), conductors shall be brought through at least 4 feet of metal raceway from the fixture to an outlet box at least one foot from the fixture. Such conductors, unless approved for the purpose, shall not extend a distance of more than 6 feet from the fixture as measured along the raceway.

"4180. Construction. For the construction of flush and recessed fixtures, see section 94105.

"4181. General. Equipment for use with electric discharge lighting systems and designed for an open-circuit voltage of 1,000 volts or less shall be of a type approved for such service. In addition to complying with the general requirements for lighting fixtures, such equipment shall conform to sections 4182 to 4187 inclusive. Transformers of the oil-filled type shall not be used. The terminals of an electric discharge lamp shall be considered as alive if any lamp terminal is connected to a potential of more than 300 volts.

D-C fluorescents to have special approval.

"4182. Direct-Current Equipment. Fixtures shall be installed on alternating-current circuits only, unless the fixtures are equipped with auxiliary equipment and resistors especially designed and approved for direct-current operation and the fixtures are so marked.

Residence voltage limit of 1000 volts. Note that this is *"open circuit"* voltage.

"4183. Voltages—Dwelling Occupancies. Equipment having an open-circuit voltage of more than 1000 volts shall not be installed in dwelling occupancies. Equipment having an open-circuit voltage of more than 300 volts shall not be installed in dwelling occupancies unless such equipment is so designed that there shall be no exposed live parts when lamps are being inserted, in place, or being removed.

"4184. Fixture Mounting. Fixtures having exposed ballasts or transformers shall be so installed that such ballasts or transformers shall not be in contact with combustible material.

To be metal enclosed. Note: Remotely located ballasts, etc. to be in metal cabinets.

"4185. Auxiliary Equipment Not Integral with Fixture. Auxiliary equipment, including reactors, capacitors, resistors, and similar equipment, where not installed as part of a lighting fixture assembly shall be enclosed in accessible, permanently-installed metal cabinets. Such separate equipment should be installed close to the lamps to keep the conductors between lamps and auxiliaries as short as possible. Where display cases are not permanently installed, no portion of a secondary circuit may be included in more than a single case.

"4186. Auto-Transformers. An auto-transformer which is used as part of a ballast for supplying lighting units and which raises the voltage to more than 300 volts shall be supplied only by a grounded system.

"4187. Switches. Snap switches shall conform to section 3814.

Series circuits to be governed by separate set of rules. Dividing line is 1000 volts.

"4191. General. Equipment for use with electric discharge lighting systems and designed for an open-circuit voltage of more than 1,000 volts shall be of a type approved for such service. In addition to complying with the general requirements for lighting fixtures, such equipment shall conform to sections 4191 to section 4203 inclusive. The terminal of an electric discharge lamp shall be considered as alive when any terminal is connected to a potential of more than 300 volts.

For signs and outline lighting, see Article 600.

"4192. Control. Fixtures or lamp installations shall be controlled either singly or in groups by an externally-operable switch or circuit-breaker which will open all ungrounded primary conductors. The switch or circuit-breaker shall be located within sight of the fixtures or lamps, or it may be located elsewhere if it is provided with means for locking in the open position.

"4193. Switches. Snap switches shall conform to section 3814.

"4194. Transformer Ratings. Transformers and ballasts shall have a secondary open-circuit voltage of not more than 15,000 volts with an allowance on test of 1,000 volts additional. The secondary current rating shall not be more than 240 milli-amperes. When the open circuit voltage is more than 7,500 volts, the secondary current rating shall not be more than 120 milli-amperes.

"4195. Transformer Type. Transformers shall be of an approved enclosed type. Transformers of other than the askarel filled or air-cooled type shall not be used.

"4196. Transformer Secondary Connections. The high-voltage windings of transformers shall not be connected in series or in parallel, except that for two transformers each having one end of its high-voltage winding grounded and connected to the enclosure, the high-voltage windings may be connected in series to form the equivalent of a mid-point grounded transformer. The grounded ends shall be connected by an insulated conductor not smaller than No. 14.

To be accessible, and so located to not subject combustible materials to excessive temperatures. (i.e. should not be located in closely confining frame recesses).

"4197. Location of Transformers. Transformers shall be accessible after installation. The transformers should be installed as near to the lamps as practicable to keep the secondary conductors as short as possible. Transformers shall be so located that adjacent combustible materials will not be subject to temperatures in excess of 90C.

"4198. Wiring Method, Secondary Conductors. Approved gas-tube sign cable suitable for the voltage of the circuit shall be used. For installation of conductors see section 6031.

"4199. Transformer Loading. The lamps connected to any transformer shall be of such length and characteristics as not to cause a condition of continuous over-voltage on the transformer.

"4200. Lamp Supports. Lamps shall be adequately supported as required in section 6033.

"4201. Mechanical Injury. Lamps shall not be located where normally exposed to mechanical injury.

To be so designed that no live parts are exposed.

'4202. Lamp Terminals and Lampholders. Parts which must be removed for lamp replacement shall be hinged or fastened by an approved means. Lamps or lampholders or both shall be so designated that there shall be no exposed live parts when lamps are being inserted or are being removed; this requirement shall be in force one year from the effective date of this code, previous to that time, section 6011 of this code may be applied.

"4203. Marking. Each fixture or each secondary circuit of tubing having an open-circuit voltage of more than 1,000 volts shall have a clearly legible marking in letters not less than 1/4 inch high reading "Caution.....volts." The voltage indicated shall be the rated open-circuit voltage.

Arc Lamps

"4205. General. Arc lamps used in theatres shall conform to section 5284, and arc lamps used in projection machines shall conform to section 5431. Arc lamps used on constant-current systems shall conform to section 7104.

Grounding

"4211. General. Fixtures and lighting equipment shall be grounded as provided in sections 4212 to 4216 inclusive.

"4212. Metallic Wiring Systems. Metal fixtures installed on outlets wired with grounded metal raceway or grounded armored cable shall be grounded.

"4213. Non-Metallic Wiring Systems. Metal fixtures installed on outlets wired with knob-and-tube-work, or non-metallic sheathed cable, on circuits operating at 150 volts or less to ground, shall be grounded except as follows:

1. Fixtures mounted on metal or metal lath ceilings or walls may be insulated from their supports and from the metal lath by the use of insulating joints or fixture supports and canopy insulators. See section 4215.

2. Fixtures not mounted on metal or metal-lath ceilings or walls need be neither insulated nor grounded. See section 4215.

Fixtures made of insulating materials, and lampholders with shells of insulating material, are recommended for use with wiring systems that do not afford a ready means for grounding the exposed non-current-carrying parts of fixtures and lampholders.

"4214. Equipment of More Than 150 Volts to Ground. Metal fixtures, transformers and transformer enclosures on circuits operating at more than 150 volts to ground shall be grounded. Other exposed metal parts shall be grounded unless they are insulated from ground and other conducting surfaces and are inaccessible to unqualified persons, except that lamp tie wires, mounting screws, clips and decorative bands on glass lamps spaced not less than 1 1/2 inches from lamp terminals need not be grounded.

"4215. Fixtures, Lampholders and Receptacle Plates Near Grounded Surfaces. Ungrounded metal lighting fixtures, lampholders and face plates shall not be installed within 8 feet vertically or 5 feet horizontally of laundry tubs, bath tubs, shower baths, plumbing fixtures, steam pipes or other grounded metal work or grounded surfaces. Metal pull chains used at these locations shall be provided with insulating links.

"4216. Methods of Grounding. Equipment shall be considered as grounded when mechanically connected in a permanent and effective manner to metal raceway, the armor of armored cable, the grounding conductor in non-metallic sheathed cable, a separate grounding conductor not smaller than Na. 14, or to gas piping, provided that the raceway, armor, grounding conductor, or gas pipe is grounded in a manner specified in Article 250."

Art. 4237—Infra-Red

New regulations allow for connection to standard branch circuits, and series operation. Each strip considered an appliance. Approved lampholders required.

"4237. Infra-Red Lamp Industrial Heating Appliances. Infra-red heating lamps rated at 300 watts or less may be used with lampholders of the medium based unswitch porcelain type, or other types approved for the purpose. Screw shell lampholders shall not be used with infra-red lamps over 300 watts rating unless the lampholders are especially approved for the purpose. These lampholders may be connected to any of the branch circuits of Article 210 and, in industrial occupancies may be operated in series on circuits of more than 150 volts to ground provided the voltage rating of the lampholders is not less than the circuit voltage.

Each section, panel or strip carrying a number of infra-red lampholders (including the internal wiring of such section, panel or strip) is considered an appliance. The terminal connection block of each such assembly is deemed an individual outlet."

Art. 4513—Industrial Networks

New regulations allow for parallel operation of transformer secondaries, and use of limiters as well as fuses.

"4513. Secondary Ties. As used in this section the word transformer means a transformer or a bank of transformers operating as a unit. A secondary tie is a circuit operating at 600 volts or less between phases which connects two power sources or power supply points, such as the secondaries of two transformers. The tie may consist of one or more conductors per phase.

a. Tie Circuits. Tie circuits shall be provided at each end with overcurrent protection as required in Article 240 of this code, except under the conditions described in sub-paragraphs 1 and 2 of this section, in which cases, the overcurrent protection may be in accordance with sub-paragraph 3 of this section.

1. Loads at Transformer Supply Points Only. If all loads are connected at the transformer supply points at each end of the tie and overcurrent protection is not provided in accordance with Article 240, the rated current-carrying capacity of the tie shall be not less than 67 percent of the rated secondary current of the largest transformer connected to the secondary tie system.

2. Loads Connected Between Transformer Supply Points. If load is connected to the tie at any point between transformer supply points and overcurrent protection is not provided in accordance with Article 240, the rated current-carrying capacity of the tie shall be not less than 100 percent of the rated secondary current of the largest transformer connected to the secondary tie system except as otherwise provided in sub-paragraph 4.

Art. 4607—135 percent Factor for Capacitor Circuits

Conductors and disconnecting means to have at least 135 percent capacity of rated amperage of capacitors. (Example 100 amp. capacitors require 200 amp. switch)

"**4607. Capacitor Circuits.** Capacitor circuits shall conform to the following:

a. Conductor Rating. The rating of capacitor circuit conductors shall be not less than 135 percent of the rated current of the capacitor. The rating of conductors which connect a capacitor to the terminals of a motor or to motor circuit conductors shall be not less than one-third the rating of the motor current conductors or the rating shall be determined as explained above if this method gives a greater value.

b. Overcurrent Protection. An overcurrent device shall be provided in each ungrounded conductor, except that an overcurrent device is not required for a capacitor connected on the load side of a motor overcurrent device. The rating or setting of the overcurrent device shall be as low as practicable without causing unnecessary opening of the circuit. A rating or setting of 165 to 250 percent of the rated current of the capacitor will be suitable under average conditions although the setting or rating may have to exceed 250 percent in some cases.

c. Disconnecting Means. A disconnecting device shall be provided in each ungrounded conductor except that a disconnecting device is not required for a capacitor connected on the load side of a motor disconnecting device. The disconnecting device need not open all ungrounded conductor simultaneously. The disconnecting device may be used for disconnecting the capacitor from the line as a regular operating procedure. The continuous current carrying capacity of the disconnecting device shall be not less than 135 percent of the rated current of the capacitor."

Art. 500—Hazardous Locations

Two subdivisions now included—Division 1 where vapors exist continuously rigid conduit required, Division 2 where vapors are normally confined within containers, rigid conduit or electric metallic tubing may be used.

Division 2 allows for "twilight" or "fringe" rulings where something more than ordinary construction required but all explosion-proof not justifiable. Still subject to discretion of authority enforcing the Code.

CHAPTER 5. SPECIAL OCCUPANCIES
ARTICLE 500—HAZARDOUS LOCATIONS

"Because of differences in characteristics of hazardous atmospheres, design and construction of equipment for use in a specific hazardous location must take into account the characteristics of the atmosphere. Facilities have been made available for testing equipment for use in the following atmospheres:

Class I, Group A, Atmospheres containing acetylene;

Class I, Group B, Atmospheres containing hydrogen or gases or vapors of equivalent hazard such as manufactured gas;

Class I, G Group C, Atmospheres containing ethyl ether vapor;

Class I, Group D, Atmospheres containing gasoline, petroleum, naptha, alcohols, acetone, lacquer solvent vapors, and natural gas;

Class II, Group E, Atmospheres containing metal dust;

Class II, Group F, Atmospheres containing carbon black, coal or coke dust;

Class II, Group G, Atmospheres containing grain dust.

"**5001. Scope.** The provisions of this article apply to locations in which the authority enforcing this code judges the apparatus and wiring to be subject to the conditions indicated by the following classifications. It is intended that each room, section or area (including motor and generator rooms, and rooms for the enclosure of control equipment) shall be considered individually in determining its classification. Except as modified by this article, all other applicable rules contained in this code shall apply to electrical apparatus and wiring installed in hazardous locations. For garages, see Article 510. For definition of 'approved' as used in this article see Article 100.

"The farm explosion-proof as used in this article shall mean, enclosed in a case which is capable of withstanding an explosion of a specified gas or vapor which may occur within it, and of preventing the ignition of the specified gas or vapor surrounding the enclosure by sparks, flashes or explosions of the gas or vapor within.

"Through the exercise of ingenuity in the layout of electrical installations for hazardous locations, it is frequently possible to locate much of the equipment in less hazardous or in non-hazardous areas and thus to reduce the amount of special equipment required. It is recommended that the authority enforcing the code be consulted before such layouts are prepared. It is recommended also that the code enforcing authority be familiar with such recorded industrial experience as well as with such standards of the National Fire Protection Association as may be of use in the classification of various areas with respect to hazard.

For recommendations for protection against static electricity hazards, refer to the standards of the National Fire Protection Association on this subject.

"**5002. Special Precaution.** The intent of this article is to require a form of construction of equipment, and of installation that will insure safe performance under conditions of proper use and maintenance. It, therefore, is assumed that inspection authorities and users will exercise more than ordinary care with regard to installation and maintenance.

"**5003. Paints, Lacquers and Finishes.** The provisions of this section shall apply to locations which are or may be hazardous because of readily ignitable deposits or residues from paints, varnishes, lacquers or other types of finishes.

In general, readily ignitable deposits occur in the interior of spray booths and of their ventilating ducts; in areas where hazardous lacquers or finishes are regularly or frequently applied by spraying, dipping, brushing, or by other means and which are not enclosed by booths; or in areas where drippage, spillage or leakage of hazardous lacquers or finishes may occur. Not all paints and finishes are classed as readily ignitable, and the residues from some are relatively non-hazardous. The character of the materials that may be used should be taken into consideration in the application of rules contained in this section.

For locations involving volatile flammable solvents or thinners refer also to section 5004.

a. Electrical Equipment. No electrical equipment or apparatus shall be installed or used in any location where readily ignitable residues may be deposited, except that wiring in rigid conduit or in boxes or fittings, containing no taps, splices or terminal connections may be installed in such locations.

b. Lighting Thorugh Glass Panels. Illumination of hazardous areas through panels of glass or other transparent material is permissable only if fixed lighting units are used as the source of illumination, if the panel effectively isolates the hazardous area from the area in which the lighting unit is located, if the lighting unit itself is approved for the locaton in which it is located, if the transparent panel is of a material or is so protected that breakage will be unlikely, and if the arrangement is such that normal accumulations of hazardous residue on the exposed surface of the panel will not be raised to a dangerous temperature by radiation or conduction from the source of illumination.

"**5004. Class I Locations.** Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations shall include the following:

a. Class I, Division 1. Locations (1) in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently, or periodically under normal operating conditions, (2) in which hazardous concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage, or (3) in which breakdown or faulty operation of equipment of processes which might release hazardous concen-

trations of flammable gases or vapors, might also cause simultaneous failure of electrical equipment.

This classification would usually include locations where flammable volatile liquids or liquified flammable gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; locations containing fat and oil extraction apparatus using volatile flammable solvents; portions of cleaning and dyeing plants where hazardous liquids are used; gas generator rooms and other portions of gas manufacturing plants where flammable gas may escape; pump rooms for flammable gas or for volatile flammable liquids; and all other locations where hazardous concentrations of flammable vapors of gases are likely to occur in the course of normal operations.

For protection against the hazards of flammable anesthetics used in hospital operating rooms refer to the standards of the National Fire Protection Association on the subject.

b. Class I, Division 2. Locations (1) in which flammable volatile liquids or flammable gases are handled, processed or used, but in which the hazardous liquids, vapors or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems or in case of abnormal operation of equipment, (2) in which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation, but which might become hazardous through failure or abnormal operation of the ventilating equipment, or (3) which are adjacent to Class I, Division I locations, and to which hazardous concentrations of gases or vapors might occasionally be communicated.

This classification would usually include locations where flammable volatile liquids or flammable gases or vapors are used, but which, in the judgment of the code enforcing authority, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of hazardous material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that should receive consideration in determining the classification and extent of each hazardous area.

Piping without valves, checks, meters and similar devices would not ordinarily be deemed to introduce a hazardous condition even though used for hazardous liquids or gases. Locations used for the storage of hazardous liquids or of liquified or compressed gases in sealed containers would not normally be considered hazardous unless subject to other hazardous conditions also.

a. Class II, Division 1. Locations (1) in which combustible dust is or may be in suspension in the air continuously, intermittently, or periodically under normal operating conditions, in quantities sufficent to produce explosive or ignitable mixtures, (2) where the normal or abnormal operation or the failure of equipment or apparatus might cause such mixtures to be produced in or in the vicinity of electrical equipment or apparatus, or (3) in which dusts of an electrically conducting nature may be present.

This classification would usually include the working areas of grain handling and storage plants; rooms containing grinders or pulverizers, cleaners, graders, scalpers, open conveyors or spouts, open bins or hoppers, mixers or blenders, automatic or hopper scales, packing machinery, elevator heads and boots, stock distributors, dust and stock collectors (except all-metal collectors vented to the outside), and all similar dust producing machinery and equipment in grain processing plants, starch plants, sugar pulverizing plants, malting plants, hay grinding plants, and other occupancies of similar nature; coal pulverizing plants (except where the pulverizing equipment is essentially dust-tight); all working areas where metal dusts and powders are produced processed, handled, packed or stored (except in tight containers); and all other similar locations where combustible dust may, under normal conditions, be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Combustible dusts which are electrically non-conducting will include dusts produced in the handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and wood flour, oil meal from beans and seed, dried hay, and other organic materials which may produce combustible dusts when processed or handled. Electrically conducting non-metallic dusts will include dusts from pulverized coal, coke and charcoal. Metallic dusts from magnesium, aluminum and aluminum bronze are particularly hazardous, and every precaution must be taken to avoid ignition and explosion.

b. Class II, Division 2. Locations in which combustible dust will not normally be in suspension in the air, or will not be likely to be thrown into suspension by the normal or abnormal operation or the failure of equipment or apparatus, in quantities sufficient to produce explosive or ignitable mixtures, but (1) where deposits or accumulations of such dust may be sufficient to interfere with the safe dissipation of heat from electrical equipment or apparatus, or (2) where such deposits or accumulations of dust on, in or in the vicinity of electrical equipment might be ignited by arcs, sparks or burning material from such equipment.

Locations where dangerous concentrations of suspended dust would not be likely, but where dust accumulations might form on, in or in the vicinity of electrical equipment, would include rooms and areas containing only closed spouting and conveyors, closed bins or hoppers, or machines and equipment from which appreciable quantities of dust would escape only under abnormal operating conditions; rooms or areas adjacent to locations described in paragraph a of this section, and into which explosive or ignitable concentrations of suspended dust might be communicated only under abnormal operating conditions; rooms or areas where the formation of explosive or ignitable concentrations of suspended dust is prevented by the operation of effective dust control equipment; warehouses and shipping rooms where dust producing materials are stored or handled only in bags or containers; and other similar locations.

a. Class III, Division 1. Locations in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used.

Such locations would include some parts of rayon, cotton and other textile mills; combustible fiber manufacturing and processing plants; cotton gins and cotton-seed mills; flax processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

b. Class III, Division 2. Locations in which easily ignitable fibers are stored or handled (except in process of manufacture).

Easily ignitable fibers and flyings will include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fibre, oakum, baled waste, kapok, Spanish moss, excelsior and other materials of similar nature.

Art. 5151—Garages. Bulk Storage Plants (Gasoline)

New regulations to apply particularly to storage plants.

"5151. Bulk-Storage Plants. Equipment for bulk-storage plants handling gasoline or other volatile liquids with similar hazards, shall conform to sections 5152 to 5157 inclusive.

5152 Equipment. Motors, controllers wiring, and equipment used as part of the bulk plant shall comply with the provisions of Class I, Division 2, of Article 500 of this code.

"5153. Underground Wiring. Wiring located in not less than 2 feet of earth may be in rigid conduit, or an approved lead-covered cable assembly, provided that rigid conduit is used where these cables leave the earth extending from a point of lowest buried cable level to the equipment so served. All wiring above the cable trench level shall conform to the provisions of Class I, Division 2, of article 500 of this code.

"5154. Pole Standards. All wiring located 15 feet or less above the ground level shall conform to the provisions of Class I, Division 2, of Article 500 of this code.

"5155. Platforms. All wiring located on filling platforms shall comply with the provisions of Class I, Division 2, of Article 500 of this code.

"5156. Storage and Repair Garages for Tank Trucks. All wiring shall conform to the provisions of Class I, Division 2, of Article 500 of this code.

"5157. Office Buildings. In office buildings, boiler rooms, and other building units isolated by location and in which no gasoline or containers are used or stored, the wiring shall comply with the provisions of Article 300 of this code."

Advertisers' Product Index

ELECTRICAL CONTRACTING • SEPTEMBER, 1946

The listings under major product headings are of manufacturers advertising those products in this issue in sufficient detail to be of value to specifiers or users of those products.

It is recommended that manufacturers' advertisements listed under each product heading be referred to in order to get complete information.

Lighting Equipment & Lamps

Motors, Motor-Driven Apparatus, Generators, Parts & Accessories

Motor Control Apparatus

Non-Metallic Sheathed Cable

Outdoor Wire, Cable & Accessories

Outlet Boxes, Metal

Panelboards, Switchboards, Switchgear, Instruments and Accessories

Porcelain Knobs, Tubes, Cleats, Outlet Boxes

Raceways, Underfloor

Signalling & Sound Systems, Chimes, Specialties

Solderless Lugs & Accessories

Surface Metal Raceways & Fittings

Switches, Safety, Meter & Entrance

Time Switches, Lighting Control & Timers

Tools

Transformers

Wire & Cable

Wire & Cable Accessories

Wiring Devices

Miscellaneous

GREENLEE TOOL CO.

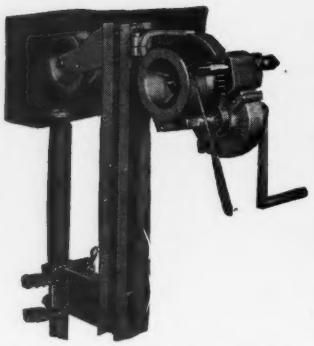
DIVISION OF GREENLEE BROS. & CO. 1749 COLUMBIA AVENUE, ROCKFORD, ILL.

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

PIPE AND CONDUIT BENDERS

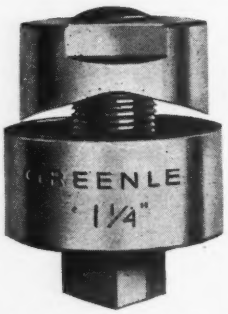
Produce smooth, accurate bends in rigid and thin-wall conduit, pipe up to 4½", tubing and bus-bars. By simply pumping handle one man can apply up to 40 tons hydraulic pressure. Two models available: No. 770 for pipe up to 3"; No. 775, up to 4½" pipe. GREENLEE Benders are easily carried to the job, set up and operated by one man. Small hand benders also available for steel, copper, brass and aluminum tubing up to ¾".

CABLE PULLERS



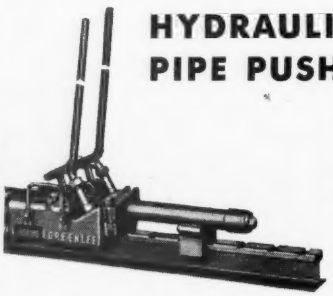
Replace cumbersome, heavy equipment and eliminate electricians' difficulties in proper anchorage. Clamping device fastens direct to conduit through which cable is pulled . . . prevents loosening of hangers or damage to cable, allows pulling in line with conduit. GREENLEE Cable Puller exerts 7,500 lb. maximum pull, has 2 speeds. To pull from concealed conduit, a flexible elbow attachment is available to make possible the use of puller without frame.

KNOCKOUT TOOLS



Eliminate time spent in drilling and filing to enlarge a hole for conduit or cable. GREENLEE Cutter or Punch can cut a hole up to 3½" in 1½ minutes or less. Tool is inserted in knockout or small drilled hole, a few turns of the drive nut with an ordinary wrench—job's done! These tools cut clean, round holes in bakelite, hard rubber or any metal up to ⅛" thick. GREENLEE Radio Chassis Punches also available for cutting openings—for sockets, plugs, other receptacles.

HYDRAULIC PIPE PUSHERS



Pushes pipe under ground . . . eliminates cost of digging long trenches, tearing up pavements and lawns, back-filling and repaving. Two models: No. 790 has pressure up to 40,000 lbs. for pipe from ¾" to 4"; No. 795 handles large ducts, pipe, etc., beyond 4", with pressure up to 150,000 lbs. 6 speeds for varying soil conditions. Compact, portable. Hand or power pump operated.

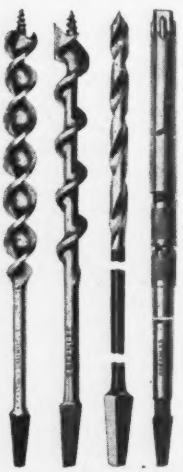
BORING TOOLS

No. 16 Unispur Electricians' Auger Bit—Fast, easy, smooth boring—1" in 8 turns. Over-all length 10", with 5½" twist.

No. 21 Solid-Center Electricians' Auger Bit . . . 1" in 8 turns. Solid center provides ample strength and chip clearance. Has 5½" twist and over-all length of 10".

No. 48 Bell Hangers' Drill—Entire tool heat-treated for extra strength. Over-all length varies from 12" to 24", with 3¾" twist.

No. 900 Bit Extension—Positive lock prevents loosening of holding sleeve, insures absolute grip on shank. GREENLEE Bit Extensions are made in 2 sizes for driving bits up to 2".



No. 16 No. 21 No. 48 No. 900

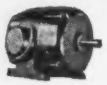
OTHER TIME-SAVING GREENLEE TOOLS

Joist Borers • Expansive Bits
Car Bits • Automatic Push
Drills • Spiral Screw Drivers
Socket Butt Chisels • Socket
Firmer Chisels • Turning Tools

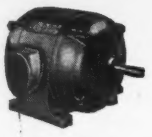
FREE CATALOG 33E Contains complete story of GREENLEE line of tools. Write for your copy today. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1749 Columbia Avenue, Rockford, Illinois.

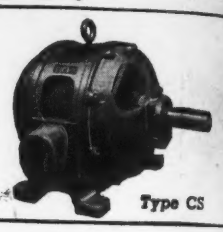
INTEGRAL HP MOTORS


Type CRP


Type CJP


Type CTP


Type CSP

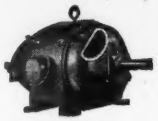
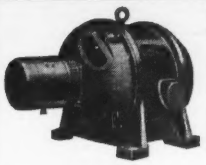
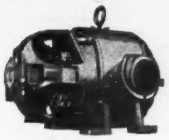

Type CS

Motor Design		Repulsion-Start Induction-Run	Repulsion Induction	Capacitor	Squirrel-Cage Induction				
TYPE		CRP	CU	CJP CTP	CSP[1]	CS[2]	CS[3]	CS[4]	CS
Starting Method		Repulsion	Repulsion	Capacitor	Across-the-Line or Reduced Voltage				
Starting Torque		High	High	Normal and High	Normal	Normal	High	High Torque High Slip	High To High S
Hp Range—Motor		¾ to 5	2 to 7½	¾ to 10	½ to 5	½ to 200	3 to 150	½ to 125	1½ to
Hp Range Gearmotor		1 to 5	2 to 7½	Refer to Works	1 to 5	1 to 75	1 to 75	Refer to Works	1 to 2
Speed Characteristics		Constant	Constant	Constant	Constant	Constant	Constant	Constant	Consta
Approx. Full Load Rpm	60 Cycle	3450 1750 1160	1750 1160	3450 1755 1160	3450, 1755, 1165, 860, 700	3450, 1755, 1165, 860, 700	3450, 1750, 1160, 870, 700	Depends Upon % slip 5% to 13% Slip Available	1600 1050 800
	50 Cycle	2880 1450 965	2880 1450 965	2880 1450 965	2880 1450 965	2880 1450 965	2880 1450 965		1340 880 670
	25 Cycle	1450	1450	1450	1450 725 480	1450 725 480	1450 725 480		1300 650
Standard Voltages		115/230	115/230	115/230	110 to 550	208 to 2300	208 to 2300	208 to 550	208 to
Temperature Rise (Continuous Duty—Open)		40° C.	40° C.	40° C.	40° C.	40° C.	40° C.	40° C.	50° C. Intermit
Type of Bearings		Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ba
Method of Reversing		Rocker Ring Adjust.	Rocker Ring Adjust.	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—U Suitable Control
					1 Linestart	2 Linestart Class I	3 Linestart Class II	4 Punch Press	5 Crane Hoist

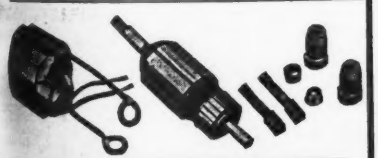
FRACTIONAL HP MOTORS

Motor Design		Induction		Capacitor		Induction	Shunt or Compo Wound
TYPE		FHT Split-Phase	FH Split-Phase	FJ Capacitor-Start	FL Capacitor-Start and Run	FS	FK
Starting Method		Across-the-Line (Full Voltage)	Across-the-Line (Full Voltage)	Across-the-Line (Full Voltage)	Across-the-Line (Full Voltage)	Across-the-Line (Full Voltage)	Full or Reduced Volta
Starting Torque		High	Medium	Extra High	Low	High	Extra High
Hp Range		1/6 to 1/3	1/20 to 1/3	1/6 to 3/4	1/20 to 3/4	1/6 to 3/4	1/20 to 3/4
Speed Characteristics		Constant	Constant	Constant	Constant or Adjustable Varying	Constant	Constant or Adjustable Vary
Approx. Full Load Rpm	60 Cycle	1725	3450 1725 1140	3450 1725 1140	1620 1080 820	60/50 { 3450/2850 1725/1425 1140/960	3450 1725 1140
	50 Cycle	1425	1425	1425	1350		
	25 Cycle	1425	1425	1425	1350	1425	
Standard Voltages		110,220	115,230	115,230	115,230	220, 440, 550	32, 115, 230
Reversing	At Rest	Yes	Yes	Yes	Yes	Yes	Yes
	In Motion	No	No ■	No ■	No	Yes	No ■
Temperature Rise (Continuous Duty Open Motor)		40° C.	40° C.	40° C.	40° C.	40° C.	40° C.
Bearings		Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve or Ba

■ *Except with Special Design*

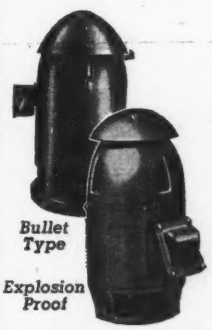
			DIRECT-CURRENT	
 Type CW	 Type CI	 Type G	 Type SK	
Wound Rotor Induction		Synchronous	Shunt, Ser. or Comp. Wound	Series or Comp. Wound
CW	CI[6]	G	SK	CKI[7]
Across-the-Line or Reduced Voltage		Across-the-Line or Reduced Voltage	Across-the-Line or Reduced Voltage	
High	High	Normal	High	High
½ to 200	¾ to 200	20 to 200	½ to 200	5 to 100
1 to 75	1 to 25	Not available	1 to 7½	....
Varying	Varying	Constant	Constant-Varying	Varying
1740, 1145, 860, 675	1740, 1140, 860, 680, 565	1800, 1200, 900, 720, 600, 514	1750 1150 850 690 575	1350 1000 875 750
1450 965	1430, 950, 710, 575, 480	1500, 1000, 750, 720		
1500 750 500	710 470	750 500		
208 to 550 and 2300	208 to 550	208 to 2300	115 to 600	230
40° C.	50° C. Intermittent	40° C.	40° C.	55° C. Intermittent
Sleeve or Ball	Sleeve or Ball	Sleeve or Ball	Sleeve, Ball or Roller	Sleeve or Roller
Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control	Change Leads—Use Suitable Control
6 Crane & Hoist				7 Crane & Hoist

UNIVERSAL (A-C or D-C)



Universal Non-Compensated	Universal Compensated
ADS Salient Pole	AD Distributed Winding
Across-the-Line (Full Voltage)	Across-the-Line (Full Voltage)
Extra High	Extra High
1/100 to 1/4	1/4 to 1
Varying	Varying
1500 to 15,000	2500 to 15,000
115,230	115,230
No ■	No ■
No ■	No ■
40° C.	40° C.
Sleeve or Ball	Sleeve or Ball

A-C AND D-C VERTICAL MOTORS


Bullet Type

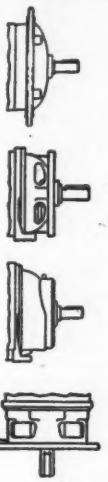
Explosion Proof

Weatherproof — Normal or high thrust vertical motors can be furnished in weatherproof construction with either hollow or solid shafts. Motor types include: Squirrel Cage Type CS (1-200 hp); Single Phase Type CT (1-10 hp); Wound Rotor Type CW (20-200 hp); and Direct Current Type SK (3-200 hp).

Explosion Proof—Hollow shaft and solid shaft motors are available for Class I, Group D Hazardous Locations, approved by Underwriters' Laboratories, Inc., and carrying their label.

ELECTRICAL AND MECHANICAL MODIFICATIONS

MOUNTINGS (Other than Horizontal)



Type "A" Flange — Wide machine mounting flange located back of bearing housing on rear bracket (shaft extension end).

Type "B" Flange — Machined flange extending beyond motor end bracket (shaft extension end) principally used for built-in applications.

Face Type (Close Coupled Pump — Face type bracket supplied on shaft extension end machined for direct mounting to driven device.

Vertical — Supplied with or without ring base to meet all solid shaft vertical drive requirements.

Resilient—Rubber rings cushion mechanical and torsional vibrations.

STANDARD ENCLOSURES (Other than Open)


Totally Enclosed Fan-cooled


Explosion Proof


Splash Proof

Totally-Enclosed (Non-ventilated or Fan-cooled)—For locations involving abrasive or metallic dust. Fan-cooled motors can be supplied with Underwriters' label for Class II, Groups E, F and G hazardous locations.

Explosion Proof — For use in atmosphere containing explosive mixtures. Can be furnished with Underwriters' label for Class I, Group D hazardous locations.

Splashproof — Provides full protection from dripping or splashing liquids or from flying chips and particles.

SPECIAL MODIFICATIONS

To meet special operating conditions, special modifications such as intermittent ratings, special frequencies, voltages, insulation, shafts, and ratings for special temperatures can be supplied. Refer to District Office for details.

BURNOUT PROTECTION


Automatic Reset Thermoguard

Thermoguard, a bi-metallic disc, provides protection against overheating of motors by snapping open under conditions of excessive heat at a predetermined temperature. Available for automatic, time delay or manual operation.

SQUIRREL CAGE — NON-REVERSING

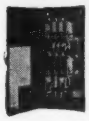
	Manual			Magnetic		
						
CLASS	10-015	10-023	10-030	11-200	11-202	11-203 (fusible) 11-204 (non-fusible)
Designation	Motor Snap Switch	Sentinel Breaker (Type H)	Face Plate Rheostat	"De-ion" Line-starter	"De-ion" Line-starter (oil immersed)	"De-ion" Comb. Linestarter
Hp Range	To 2	To 1	To 10	To 750	To 200	To 200
Phase	1, 2 & 3	Single only	Single only	1, 2 & 3	2 & 3	1, 2 & 3
Volts	110 to 600	110 to 220	110 to 220	110 to 600	110 to 600	110 to 600
Cycles	60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25
Type of Starting	Across-the-line	Across-the-line	Reduced voltage	Across-the-line	Across-the-line	Across-the-line
Protection	None	Overload	Low voltage	Overload & low voltage	Overload & low voltage	Short Circuit, overload & low voltage

WOUND ROTOR

	Manual		Magnetic	
				
CLASS	12-016	12-300	13-100	13-300
Designation	Speed regulating rheostat	Drum controller (Type A)	Magnetic starter	Motor operated drum controller
Hp Range	Up to 25	To 500	5 to 1000	300 to 1000
Phase	2 & 3	2 & 3	3	2 & 3
Volts	220 to 600	220 to 5000	220 to 2200	220 to 5000
Cycles	60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25
Type of Starting	Reduced by Sec. Cont.	Reduced by Sec. Cont.	Reduced by Sec. Cont.	Reduced by Sec. Cont.
Primary Control	No (Use 11-200)	No (Use 11-200)	Yes	No (Use 11-200)
Secondary Control	Yes	Yes	Yes	Yes
Protection	Included in primary control	Included in primary control	Overload and low voltage	Included in primary control

DIRECT-CURRENT

	Manual			Magnetic		
						
CLASS	10-023	10-100	7000 (7010, 7210, 7310, 7350)	8502	8512	8522
Designation	Sentinel Breaker (Type H)	"De-ion" Motor Watchman (Type DnW)	Starting and Speed Regulating Rheostats	"De-ion" Linestarter	Timestarter	Heavy Duty Timestarter
Hp Range	Up to 1	Up to 1½	Up to 200	Up to 2	Up to 10	Up to 150
Volts	32, 115, 230	115, 230	32, 115, 230, 550	115, 230	115, 230	115, 230, 550
Type of Starting	Across-the-line	Across-the-line	Reduced voltage	Across-the-line	Reduced voltage	Reduced voltage
Regulation	None	None	None and armature and/or field control	None	None	None or Field Rheo.
Protection	Overload	Overload	Low Voltage	Overload & low voltage	Overload & low voltage	Overload & low voltage

REVERSING				MULTI-SPEED	
Manual		Magnetic		Manual	Magnetic
					
10-200	10-300	11-210	11-213 (non-fusible)	10-130	11-950
Drum Switch (oil immersed)	Drum Switch (Types N&H)	"De-ion" Linestarter	"De-ion" Comb. Linestarter	"De-ion" Motor Watchman (Type DnW)	"De-ion" Starter Non-Reversing
To 3	To 15	To 400	To 50	To 7½	To 400
2 & 3	1, 2, 3	1, 2 & 3	1, 2 & 3	3	3
110 to 600	110 to 600	110 to 600	110 to 600	110 to 600	110 to 600
60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25	60, 50, 25
Across-the-line	Across-the-line	Across-the-line	Across-the-line	Across-the-line 2-speed 2-winding	Across-the-line
None	None	Overload & low voltage	Motor Circuit switch overload & low voltage	Overload	Overload & low voltage

Manual Reversing				
				
12-700	12-800	14-040	14-250	14-410
Drum controller (Type A)	Semi-Magnetic Drum controller (Type A)	Auto-transformer Semi-magnetic Type	Full magnetic Type	Full magnetic Auto-transformer Type
To 200	30 to 200	25 to 3000	25 to 3000	25 to 3000
2 & 3	2 & 3	2 & 3	2 & 3	3
60, 50, 25	220 to 2200	220 to 5000	220 to 5000	220 to 5000
220 to 600	60, 25	60, 50, 25	60, 50, 25	60, 50, 25
Reduced by Sec. Cont.	Reduced by Sec. Cont.	Reduced Voltage	Across-the-line	Reduced Voltage
Yes	Yes	Yes	Yes	Yes
Yes	Yes	....	....	....
None	Overload low voltage and over travel	Overload and low voltage, pullout	Overload and low voltage, pullout	Overload and low voltage, pullout

SYNCHRONOUS

Type STA Synchronizing Relay — Advantages: (1) Maximum non-synchronous speed before field is applied; (2) Synchronizes in minimum time; (3) Positive synchronizing sequence; (4) Minimum line disturbance; (5) Automatic pull-out protection. The Synchronizing relay—Type STA is used in the Controls listed below.

Manual Reversing		Magnetic Reversing	
			
8110	8300 Reversing 8400 Dyn. Brak Lower	8503	9022
Machine Tool Drum Controller	Drum Controller (Type A)	"De-ion" Linestarter	Heavy Duty Timestarter
Up to 35	Up to 50	Up to 2	Up to 150
115, 230	115 to 230	115, 230	115, 230, 550
Reduced voltage	Reduced voltage	Across-the-line	Reduced voltage
Field Control	Armature Control	None	None or Field Rheo.
None	None	Overload & low voltage	Overload & low voltage

MOTOR CONTROL ACCESSORIES

PUSHBUTTONS

Type HD Station for Surface Mounting

Type HDW Water-and Dust-Tight Station

Type HDE Oil Immersed Station-Overhung Design

Type SD-2 Rotary Selector Switch Station

Type SD-2 Dust-and Water-Tight Station

Westinghouse Standard and Heavy Duty Pushbuttons are designed for pilot control circuits, 110-600 volts a-c and 115-600 volts d-c. Various combinations of pushbutton units may be combined in sheet steel, water and dust-tight or oil immersed stations. Buttons are large to make operation with gloved hands easier, all are shrouded as protection against accidental operation. Double-break contact assures long, dependable operation.

Heavy Duty — Type HD — Recommended for severe service. One to seven unit stations available in standard enclosures. Special enclosures also available.

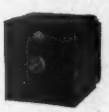
Standard Duty — Type SD-2 —Designed for use with magnetic starters and controllers. Pushbutton stations can be furnished in 1 to 3 button momentary contact station and selector switch stations for maintained contact duty.

For further information contact your nearest Westinghouse District Office or ask for Description Bulletin 15-010 on Heavy Duty Units and Descriptive Bulletin 15-020 on Standard Duty Units.

OTHER CONTROL ACCESSORIES

In addition to a complete line of Pushbuttons, Westinghouse also builds a wide variety of other control accessories, a few of which are shown below.

Type N-106 Master Switch Class 15-100-N



Heavy Duty Rheostat Type JM Class 14-525

Machine Limit Switch—Type LS Class 15-075

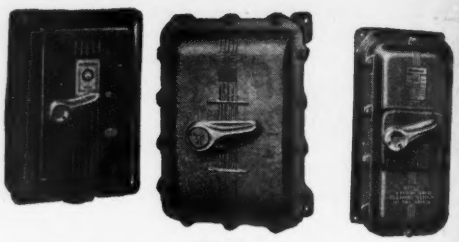
Grid Type Resistor

Solenoid Operated Brake-Type DI Class 15-075

AB-I CIRCUIT BREAKERS

Westinghouse Type AB-I Nofuze Circuit Breakers are especially designed to protect insulated conductors from the effects of over-current and short circuit, without the use of fuses. They will permit temporary harmless overloads, but will trip instantly when a dangerous overload develops. They permit quick resumption of service when once the fault has been removed. Thus the AB-I breaker prevents unnecessary work stoppage due to light overloads, and eliminates the usual delays in restoring service, as there are no fuses to replace. They find wide application in industrial plants, commercial buildings, apartment houses, or any place where fuses, fuse switches and similar protective devices are ordinarily used.

AB-I Circuit Breakers are quick-make—quick-break with "De-ion" Arc Quencher. Inverse Time Delay Overload Protection is provided by bi-metallic thermal trip. They are self-indicating showing "on," "off," "tripped" positions. The door opens only in "Open-Cover" position.



Sheet Steel Dust-Resisting | *Cast Iron Hazardous Locations* | *Cast Iron Water and Dust-tight*

SAFETY SWITCHES

Westinghouse manufactures three types of Safety Switches—A, C, and D.

TYPE A—Recommended for maximum safety and is used on motor circuits, heavy duty industrial circuits, etc. Its cover is interlocked so it cannot be opened when switch is "ON." It provides quick-make and quick-break.

TYPE C—For motor or industrial circuits where interlock is not required. Quick-make and quick-break.

TYPE D—Designed primarily for main entrance work and is not suited for motor circuits over 2 hp—250 volts.

Most Safety Switches are of one-piece copper construction. Because of one-piece construction from 2 to 7 less contact points are eliminated per hole than are used on most other switches, thus heating is reduced.

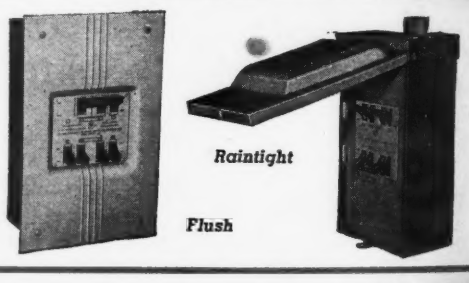
An exclusive feature of Westinghouse Single Throw Switches is the Diamond Pointed Break Jaw which keeps arcing outside of contact area. "De-ion" Arc Quenchers on all 575 volt switches.

Type A Safety Switch | *Fusible* | *Non-Fusible*

LOAD CENTERS

Westinghouse Nofuze Multi-Breaker Load Centers, Type MB and Type M, completely eliminate the need for replacing fuses that blow when a short circuit or overload endangers electrical wiring. With Nofuze circuit protection, when service is interrupted due to faults, simply flip the breaker handle first to "off," then to "on" to restore it. They are trip-free —cannot be held closed when abnormal circuit conditions exist.

Nofuze Multi-Breaker Load Centers are slow-make, slow-break with quick-break on overloads. Multi-Breakers are available in ratings from 15 to 100-amperes, 1, 2, or 3-pole either individually enclosed or in groupings up to 16 circuits for use on a-c service not exceeding 125/230 volts or 230 volts a-c.



Raintight | *Flush*

NOFUZE CIRCUIT BREAKER PANELBOARDS

Westinghouse Nofuze Circuit Breaker panelboards provide safe, adequate protection for lighting and power distribution circuits and for lighting and appliance circuits.

The use of Nofuze circuit breakers gives full circuit protection, and makes the use of fuses and switches unnecessary. Panelboards NMM and NLAB are also available in single row type for mounting on H or I-beams. For use on 10-inch column they are identified by LX suffix: for use on 8-inch column the suffix LXX is used.

All circuit breaker handles indicate when breaker has tripped automatically by assuming a different position from the normal "ON."

Nofuze Circuit Breakers are individually tested and calibrated at the factory. Each breaker carries the label of Underwriters' Laboratories, Inc.

For complete information—see quick Selector Catalog 30-000.

	FOR LIGHTING
Panelboard Type	*NMIB Multibreaker*
Description	For 115/240 Volt a-c Single phase Systems Only
Number of Circuits	4-40 Circuits, Single-Phase 3 wire Mains—2 wire branches with mains arranged for "Lugs Only" or Breaker in Mains

Panelboard Type	*NMM Multibreaker*
Description	For 115/230 Volt A-C Systems Only
Number of Circuits	4-40 Circuits, Single Phase 3 wire Mains—2 Wire Branches. 6-42 Circuits, 3 ph., 4 wire Mains—2 wire branches, with Mains arranged for "Lugs Only" or Breaker in Mains

Range of Available Ratings

AMP. RANGE PER FRAME	NO. OF POLES	VOLTAGES A-C	VOLTAGES D-C
15 to 50	2SN	125	125
15 to 50	2	250	125/250
	3	250	125/250
15 to 100	2	250 600	125/250 250
	3	250 600	125/250 250
50 to 100	2	250 600	125/250 250
	3	250 600	125/250 250
70 to 225	2	250 600	125/250 250
	3	250 600	125/250 250
225 to 600	2	250 600	125/250 250
	3	250 600	125/250 250

Standard Horsepower Ratings

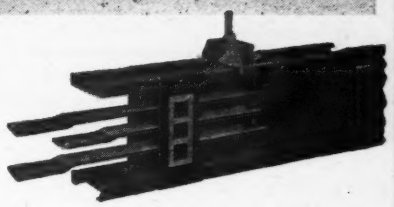
Horsepower ratings of fusible switches used with standard fuses:

ELECTRICAL RATING OF FUSED SWITCH		SWITCH RATING IN HP			ELECTRICAL RATING OF FUSED SWITCH		SWITCH RATING IN HP		
Volts	Amps	2-Pole, Single-Phase or D-C	3-Pole, 3-Phase	4-Pole, 2-Phase, 4-Wire	Volts	Amps	2-Pole, Single-Phase or D-C	3-Pole, 3-Phase	4-Pole, 2-Phase, 4-Wire
115 A-C	30	1	..	..	460 A-C	30	..	7½	7½
115 A-C	60	2	..	..	460 A-C	60	..	20	20
125 D-C	30	2	..	..	460 A-C	100	..	30	30
230 A-C	30	2	3	3	460 A-C	200	..	50	50
230 A-C	60	5	7½	10	575 A-C	30	..	7½	7½
230 A-C	100	10	15	20	575 A-C	60	..	20	20
230 A-C	200	15	30	30	575 A-C	100	..	30	30
230 A-C	400	30	50	50	575 A-C	200	..	50	50
250 D-C	30	5	..	..	600 D-C	30	7½	..	..
250 D-C	60	10	..	..	600 D-C	60	15	..	..
250 D-C	100	15	..	..	600 D-C	100	25	..	..
250 D-C	200	30	..	..	600 D-C	200	50	..	..
250 D-C	400	50	..	..					

More Commonly Used Multi-Breaker Combinations

For lighting circuits two to six 15 ampere single poles are used. If there is a water heater circuit one 20 ampere two pole breaker is required. If there is an electric range it will use either a 35 or 50 ampere two pole circuit breaker. Generally speaking the main lugs incorporating the above mentioned branches will be rated 70 amperes.

BUS DUCT



Bus Duct is a high-capacity conductor designed for industrial secondary power and distribution systems. It consists of copper bus bars supported within metal housings by Prestite insulators. Bus Duct passes Underwriters' Laboratories rigid inspection tests for safety and rigidity under impact.

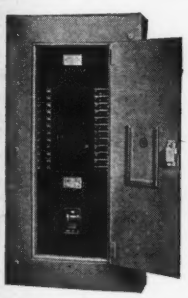
Applications

Westinghouse Bus Duct affords applications which are flexible, convenient and economical. In existing plants, it cuts time in relocating machinery . . . even entire departments. In new plants, it shortens the time between plans and production by speeding the location and the possible relocation of machinery. Available in fabricated 10-foot units ready for easy and quick installation. Prestite insulators at 12-inch intervals also serve as plug-in receptacles.

Features

Adjustable cantilever clamp hanger affords fast, fool-proof installation in that it consists of a simple, rugged clamp to be attached to a drop rod which can be shifted along top of duct. Also available with a "C" clamp for either wall or ceiling mounting; four-channel interlocking construction. This Duct also available totally enclosed. Ask for catalog B-3714.

APPLIANCE CIRCUITS — FOR DISTRIBUTION CIRCUITS

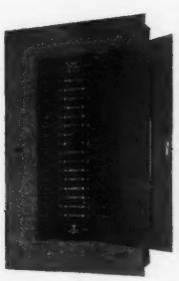


NLAB Quicklag "De-ion"

For 125/250 Volt A-C Systems

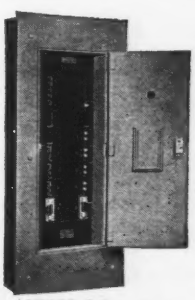
NLAB Single Row Quicklag

With Mains Arranged for "Lugs Only" or AB Breaker in Mains.



NAIB - AB "De-ion"

For 230 Volt A-C or 125/250 Volt D-C Systems. Branch Circuits 15 to 50 Amps. 1, 2 or 3 pole.



MH Multibreaker

For 230 Volt A-C System Branch Circuits, 15 to 100 Amps, 2 or 3 pole.

Number of Circuits Limited Only by Size of Cabinet and Good Engineering Practice.

AB "De-ion" Convertible

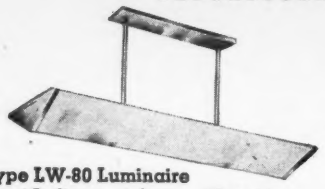
For 250 volt systems A-C or D-C and 600 Volt D-C —15 to 600 amps.

COMMERCIAL LIGHTING

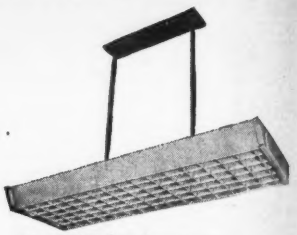
Westinghouse manufactures luminaires for all types of commercial installations. Fluorescent units are designed for individual or continuous strip, ceiling or suspension mounting. Available for semi-indirect illumination with 2 or 4, 40 watt fluorescent lamps. Furnished completely wired, ready for connection to line leads.

Incandescent commercial luminaires are made in several different styles for ceiling, semi-rigid, or chain hanger. Indirect units are used with 200 to 1000 watt lamps—general diffuse luminaires with 50 to 500 watt lamps. Luminaires can be furnished in several styles of basins. Globes are available in both "Safety Holder" and "Screw Holder" types. Hanger finish may be satin zinc, satin aluminum or dark brown baked-on enamel.

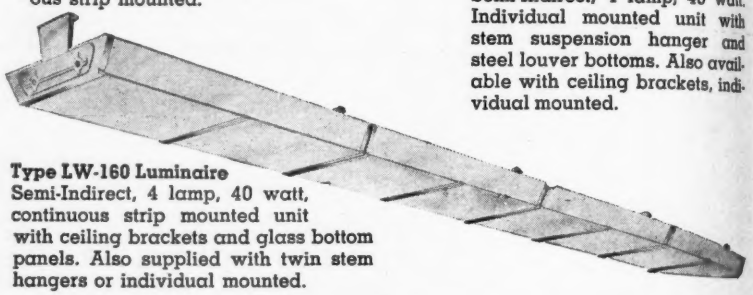
FLUORESCENT LUMINAIRES



Type LW-80 Luminaire
Semi-Indirect, 4 lamp, 40 watt, individual mounted with twin stem hanger. Also available with ceiling brackets or continuous strip mounted.



Type LW-160 Luminaire
Semi-Indirect, 4 lamp, 40 watt. Individual mounted unit with stem suspension hanger and steel louver bottoms. Also available with ceiling brackets, individual mounted.



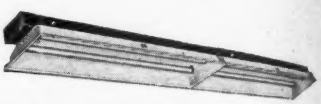
Type LW-160 Luminaire
Semi-Indirect, 4 lamp, 40 watt, continuous strip mounted unit with ceiling brackets and glass bottom panels. Also supplied with twin stem hangers or individual mounted.

INDUSTRIAL LIGHTING

Westinghouse can supply the correct fixtures to meet every indoor or outdoor industrial lighting requirement. Fluorescent units for use with 40 or 100 watt lamps are manufactured with open or closed ends, for single or continuous strip installation. Vapor- and dust-tight units, approved for Class II Group G hazardous locations are available. Units are completely wired. Locklite, Bayonet-heel, Snap-in and vapor tight reflectors can be supplied in standard dome, shallow dome, deep bowl, and symmetrical angle styles. Special types of mercury and incandescent fixtures are available — some especially adapted to extreme service conditions. A few of the many different units are shown.

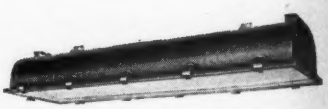
FLUORESCENT LUMINAIRES

RLM Luminaire Type FP-100



Continuous Strip RLM Luminaire Types FPS-40, FPS-100

RLM Luminaire Type FPR-40, FPR-100



Dust and Vapor-Tight Luminaire Type FDT-40

FLOODLIGHTING AND STREET LIGHTING

A complete line of light and heavy duty floodlights is available, with wide or narrow beam alzak aluminum reflectors, plain, diffusing or spread type lenses, and a full assortment of mounting arrangements. For 200 to 1500 watt lamps. Under water floodlights can also be supplied.

Westinghouse manufactures all types of luminaires for streets and highways. Units are available for top or side mounting, inner or external wiring for low or high voltage series circuits 10,000 lumens or less, also for multiple circuits of 2500 volts or less. Reflectors provide symmetric or assymmetric light distribution as desired. For use with incandescent, sodium or mercury incandescent lamps. A wide selection of poles, brackets and accessories complete the line. Consult your nearest Westinghouse representative.

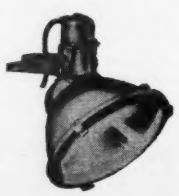
FLOODLIGHTING

AH-16 (A-16)

A-14 (AH-14)

CAK-20

A-10



VRC-18

AF-16, AFA-16

INCANDESCENT UNITS

Sollaire Luminaires
General Diffuse. 75, 100, 150, 200, 300, 500 watt. Available with semi-rigid, ceiling or chain hanger.

Sollite Luminaires
General Diffuse. 75, 100, 200, 300, 500 watt. Available with semi-rigid, ceiling or chain hanger.

Lunaire Luminaires
Indirect. 75, 100, 150, 200, 300, 500 watt. Available with semi-rigid, ceiling or chain hanger.

Magnalux Luminaires
Indirect. 200, 300, 500, 750 and 1000 watt. Available with semi-rigid, ceiling or chain hanger.

INCANDESCENT AND MERCURY LUMINAIRES

RLM Dome Reflector and Hood

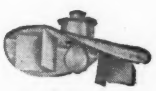
Type DT Dust-tight Luminaire

Concentrator

RLM Standard Symmetrical Angle Reflector

Focalaire Luminarie

Glassteel Diffuser Reflector



Bin and Stack Luminaire

Shallow Dome Reflector

Elliptical Angle Reflector and Hood

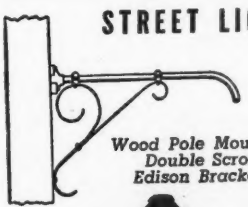
Millite Luminaire

Aluminum High Bay Reflector

RLM Standard Deep Bowl Reflector

STREET LIGHTING

Pend-a-Lite Concrete Standard with Plain Bracket



Wood Pole Mounting Double Scroll Edison Brackets

Universal Metal Hood Radial Wave Luminaire

Type AK10 Universal Metal Hood Luminaire for top mounting

Type AK15 Reflectolux Senior Luminaire with rigid hood

Type AK10 Luminaire with Type IW Hood Inner Wiring

FUNDAMENTALS OF CORRECT LIGHTING

The following items should be considered as basic in planning a lighting installation:

1. A sufficient quantity of light should be provided.
2. Illumination should be uniformly distributed.
3. Harsh shadows should be prevented.
4. Direct and reflected glare should be avoided.
5. Proper direction light should be provided.
6. Annoying radiant heat should be avoided.
7. Light should be suitable color.

Design Considerations

In laying out any type of lighting installation, it is necessary to carry out the following.

1. Consider the type of interior construction and the specific activities for which the room or building is designed, which in turn will determine the type of fixture and lamps to be used.

2. Ascertain very carefully, the area, ceiling height, wall and ceiling reflection factors, and the mounting height of the fixtures to be installed. Next, calculate the average maintained footcandles for a given task. See Westinghouse Publications, "Lighting Handbook," "Lighting Application Manual."

3. It is then necessary to determine the method of mounting, considering not only ease of installation, but efficient operating maintenance.

Maintenance

Maintenance is an integral part of any lighting design and good lighting remains as such only if it receives proper maintenance care.

A large area plant, for example, requires constant maintenance attention. Lamp outages must be promptly replaced and reflectors should be cleaned every 3 or 4 months. A large accumulation of dust can reduce illumination as much as 50% in a relatively short time.

Where units are mounted at a great height, equipment can be serviced by catwalks, a traveling monorail bridge or luminaires can be installed in such a way that they can be easily lowered to the floor for servicing. Luminaires at 15 to 20-foot mounting height can be reached by a ladder or elevated platform for maintenance.

Equipment

LAMPS—A complete line is available from 6 to 100 watt fluorescent; from 6 to 10,000 watt incandescent; from 100 to 3000 watt mercury. See pages 507-512 of this catalog for detailed data on Westinghouse Lamps.

FIXTURES—Westinghouse offers a fluorescent, incandescent, and mercury unit of every type and size to meet any requirement.

Specially trained experts in every Westinghouse Sales office and Service shop will be glad to help you whenever possible with your lighting design problems.

Westinghouse Sales Offices

AKRON 8, OHIO, 106 S. Main St.
ALBANY 4, N. Y., 456 N. Pearl St.
ALLENTOWN, PA., Farr Bldg., 739-741 Hamilton St.
APPLETON, WISC., 340 W. College Ave.
*ATLANTA 2, GA., 1299 Northside Drive, N.W.
*AUGUSTA, MAINE, 9 Bowman St.
BAKERSFIELD, CALIF., 2224 San Emedio St.
BALTIMORE 2, MD., 118 E. Lombard St.
*BALTIMORE 24, MD., 4015 Foster Ave.
*BATON ROUGE, LA., 555 Choctaw Drive
BEAUMONT, TEXAS, 1213 American National Bank Bldg.
BINGHAMTON 62, N. Y., Suite 704, Marine Midland Bldg., 86 Court St.
BIRMINGHAM 3, ALA., 1407 Comer Bldg.
BLUEFIELD, W. VA., Appalachian Elec. Power Co. Bldg., P. O. Box 848
BOSTON 10, MASS., 10 High St.
BOSTON 27, MASS., 235 Old Colony Ave., S.
*BRIDGEPORT 8, CONN., 540 Grant St.
BUFFALO 3, N. Y., 814 Ellicott Square
*BUFFALO 10, N. Y., 1132 Seneca St.
BURLINGTON, VT., 208 Flynn Ave.
BUTTE, MONT., 52 E. Broadway
CANTON 2, OHIO, 901 First National Bank Bldg., 120 W. Tuscarawas St.
CEDAR RAPIDS, IOWA, 361 21st St., S.E.
CHARLESTON, S. C., 89 G. Smith St.
CHARLESTON 23, W. VA., 610 Union Bldg., P. O. Box 911
*CHARLOTTE 1, N. C., 210 E. Sixth St.
CHATTANOOGA 2, TENN., Volunteer State Life Bldg., Georgia Ave. and E. Ninth St.
CHICAGO 6, ILL., 20 N. Wacker Drive
*CHICAGO 9, ILL., 2211 W. Pershing Road
*CINCINNATI 2, OHIO, 207 W. Third St.
CLEVELAND 13, OHIO, Standard Bldg., 1370 Ontario St.
*CLEVELAND 2, OHIO, 5901 Breakwater Avenue, Station A
COLUMBUS 15, OHIO, 85 E. Gay St.
DALLAS 1, TEXAS, 209 Browder St.
DAVENPORT, IOWA, 206 E. Second St.
DAYTON 2, OHIO, 30 N. Main St.
DENVER 2, COLO., 910 Fifteenth St.
*DENVER 4, COLO., 988 Cherokee St.
DES MOINES 8, IOWA, 1400 Walnut St.
*DETROIT 31, MICH., 5757 Trumbull Ave.
DULUTH 2, MINN., 10 E. Superior St.
EL PASO, TEXAS, Oregon and Mills St.
*EMERYVILLE 8, CALIF., 5915 Green St.
ERIE, PA., 1003 State St.
EVANSVILLE 8, IND., 201 N. W. First St.
*FAIRMONT, W. VA., 10th and Beltline Ave.
FORT WAYNE 6, IND., 1010 Packard Ave.
GARY, IND., 846 Broadway
GRAND RAPIDS 2, MICH., 149 Monroe Ave., N. W.
GREENVILLE, S. C., 106 W. Tallulah Drive
HAMMOND, IND., 235 Locust St.
HARTFORD 3, CONN., 36 Pearl St.
HONOLULU, T. H., Hawaiian Elec. Co. Agt.
HOUSTON 2, TEXAS, 1314 Texas Ave.
*HOUSTON 2, TEXAS, 2315 Commerce Ave.
*HUNTINGTON 1, W. VA., 1029 Seventh Ave.
INDIANAPOLIS 9, IND., 137 S. Penna. St.
*INDIANAPOLIS 2, IND., 551 West Merrill St.
JACKSON, MICH., 212 West Michigan Ave.
JACKSON, MISS., 1011 Pecan Blvd.
JACKSONVILLE 3, FLA., 37 South Hogan St.
*JOHNSTOWN, PA., 107 Station St.
KANSAS CITY 6, MO., 101 W. Eleventh St.
KNOXVILLE 8, TENN., Gay and Clinch St.
LOS ANGELES 13, CALIF., 420 S. San Pedro St.
LOUISVILLE 2, KY., 332 West Broadway
MADISON 3, WISC., 1022 E. Washington Ave.
MEMPHIS 3, TENN., 130 Madison Ave.
MIAMI 4, FLA., 11 N. E. Sixth St.
MILWAUKEE 2, WISC., 538 N. Broadway
*MILWAUKEE 3, WISC., 424 N. Fourth St.
*MINNEAPOLIS 13, MINN., 2303 Kennedy St., N. E.
MONROE, LA., 1107 N. 2nd St.
NASHVILLE 3, TENN., 219 Second Ave., N.
NEWARK 2, N. J., 1180 Raymond Blvd.
*NEWARK 1, N. J., Haynes Ave. and Lincoln Highway
NEW HAVEN 8, CONN., 42 Church St.
NEW ORLEANS 12, LA., 333 St. Charles St.
NEW YORK 5, N. Y., 40 Wall St.
NIAGARA FALLS, N. Y., 253 Second St.
NORFOLK 1, VA., 2600 Hampton Blvd.
OKLAHOMA CITY 2, OKLA., 120 N. Robinson St.
OMAHA 2, NEB., 409 South Seventeenth St.
PEORIA 2, ILL., 418 S. Washington St.
*PHILADELPHIA 4, PA., 3001 Walnut St.
PHOENIX, ARIZ., 11 West Jefferson St.
PITTSBURGH 30, PA., 306 4th Ave.
*PITTSBURGH 8, PA., 543 N. Lang Ave.
PORTLAND 4, ORE., 309 S. W. Sixth Ave.
*PORTLAND 12, ORE., 626 Tillamook St.
*PROVIDENCE 3, R. I., 16 Elbow St.
RALEIGH, N. C., 803 N. Person St.
RICHMOND 19, VA., 301 S. Fifth St.
ROCHESTER 7, N. Y., 1048 University Ave.
ROCKFORD, ILL., 130 S. Second St.
SACRAMENTO 14, CALIF., 411 and 413 Ochsner Bldg., 719 K St.
ST. LOUIS 1, MO., 411 N. Seventh St.
*ST. LOUIS 2, MO., 717 S. Twelfth St.
SALT LAKE CITY 1, UTAH, 10 W. First South St.
*SALT LAKE CITY 7, UTAH, 346 A Pierpont Ave.
SAN ANTONIO 5, TEXAS, 115 W. Travis St.
SAN DIEGO 1, CALIF., 861 Sixth Ave.
SAN FRANSICO 4, CALIF., 1 Montgomery St.
*SEATTLE 4, WASH., 3451 East Marginal Way
SIOUX CITY 17, IOWA, 2307 Kennedy Drive
SOUTH BEND 4, IND., 216 E. Wayne St.
SPOKANE 8, WASH., 1023 W. Riverside Ave.
SPRINGFIELD, ILL., 601 E. Adams St. Box 37
*SPRINGFIELD 1, MASS., 395 Liberty St.
SYRACUSE 4, N. Y. 420 N. Geddes St.
TACOMA 2, WASH., 1115 "A" St.
TAMPA 1, FLA., 417 Ellamae Ave.
TOLEDO 4, OHIO, 245 Summit St.
TULSA 3, OKLA., 303 E. Brady St.
*UTICA 1, N. Y., 113 N. Genesee St.
WASHINGTON 6, D. C., 1625 K Street N. W.
WICHITA 2, KAN., 233 S. St. Francis Ave.
*WILKES-BARRE, PA., 267 N. Penn Ave.
WILLIAMSPORT 1, PA., 348 W. Fourth St.
WORCESTER 8, MASS., 507 Main St.
YORK, PA., 147 S. George St.
YOUNGSTOWN 3, OHIO, 25 E. Boardman St.

*Manufacturing and Repair Shop

Westinghouse Agent Jobbers

*WESTINGHOUSE ELECTRIC SUPPLY COMPANY

ALBANY 4, N. Y., 454 N. Pearl St.
ALLENTOWN, PA., 739-741 Hamilton St.
AMARILLO, TEX., First and Taylor Sts.
ATLANTA 2, GA., 1299 Northside Drive, N.W.
AUGUSTA, MAINE, 90 Water St.
BALTIMORE 2, MD., 40 S. Calvert St.
BANGOR, MAINE, 175 Broad St.
BINGHAMTON 60F, N. Y., 87 Chenango St.
BOSTON 10, MASS., 88 Pearl St.
BURLINGTON, VT., 208 Flynn Ave.
BUTTE, MONT., 50 E. Broadway
CHARLOTTE 1, N. C., 210 E. Sixth St.
CHICAGO 7, ILL., 113 N. May St.
CINCINNATI 6, OHIO, 2329 Gilbert Ave.
CLEVELAND 3, OHIO, 6545 Carnegie Ave.
COLUMBIA, S. C., 915 Lady St.
COLUMBUS 16, OHIO, 266 N. 4th St.
CORPUS CHRISTI, TEXAS, North end of Mesquite St.
DALLAS 2, TEXAS, 405 N. Griffin St.
DAVENPORT, IOWA, 402 E. Fourth St.
DES MOINES 8, IOWA, 1400 Walnut St.
DAYTON, OHIO, 226 W. 5th St.
DETROIT 2, MICH., 547 Harper Ave.
DULUTH 2, MINN., 308 W. Michigan St.
ERIE, PA., 1013 State St.
EVANSVILLE 8, IND., 201 N. W. First St.
FORT WAYNE 2, IND., 612 S. Harrison St.
FORT WORTH, TEXAS, 210 Jones St.
GRAND RAPIDS 2, MICH., 511 Monroe Ave., N. W.
GREENVILLE, S. C., 226 Pendleton St.
GREEN BAY, WIS., 619 Main St.
HEMPSTEAD, N. Y., 5 No. Franklin St.
HOUSTON 2, TEXAS, 1903 Ruiz St.
INDIANAPOLIS 9, IND., 137 S. Penna. St.
JACKSONVILLE 3, FLA., 37 S. Hogan St.
JAMAICA 2, N. Y., 153-17 Jamaica Ave.
LOS ANGELES 54, CALIF., 905 E. Second St.
MADISON 3, WISC., 1022 E. Washington Ave.
MEMPHIS 1, TENN., 366 Madison Ave.
MIAMI 4, FLA., 11 N. E. Sixth St.
MILWAUKEE 2, WISC., 546 N. Broadway
MINNEAPOLIS 5, MINN., 515 S. Seventh St.
NEWARK 5, N. J., 49 Liberty St.
NEW HAVEN 8, CONN., 240 Cedar St.
NEW ORLEANS 6, LA., 420 S. Peters St.
NEW YORK 13, N. Y., 150 Varick St.
NORFOLK 1, VA., 2600 Hampton Blvd.
OAKLAND 6, CALIF., 711 E. 8th St.
OKLAHOMA CITY 2, OKLA., 850 N. W. 2nd St.
OMAHA 2, NEB., 117 N. Thirteenth St.
PEORIA 2, ILL., 412 S. Washington St.
PHILADELPHIA 7, PA., 141 N. 11th St.
PHOENIX, ARIZ., 315 W. Jackson St.
PITTSBURGH 19, PA., 575 Sixth Ave.
PORTLAND 9, ORE., 124 N. W. Eighth St.
PROVIDENCE 1, R. I., 66 Ship St.
RALEIGH, N. C., 319 W. Martin St.
READING, PA., 4th and Elm St.
RICHMOND 19, VA., 301 S. Fifth St.
ROANOKE, VA., 726 First St., S. E.
ROCHESTER 7, N. Y., 1048 University Ave.
SACRAMENTO 14, CALIF., 719 K St.
ST. LOUIS 2, MO., 1011 Spruce St.
ST. PAUL 1, MINN., 253 E. 4th St.
SALT LAKE CITY 11, UTAH, 235 W. South Temple St.
SAN ANTONIO 6, TEXAS, 1211 E. Houston St.
SAN FRANCISCO 1, CALIF., 260 Fifth St.
SEATTLE 4, WASH., 1051 First Ave., So.
SIOUX CITY 4, IOWA, 1005 Dace St.
SPOKANE 1, WASH., 152 So. Monroe St.
SPRINGFIELD 3, MASS., 46 Hampden St.
SYRACUSE 4, N. Y., 961 W. Genesee St.
TACOMA 2, WASH., 1115 "A" St.
TAMPA 1, FLA., 417 Ellamae St.
TOLEDO 2, OHIO, 1920 N. Thirteenth St.
TRENTON 10, N. J., 444 S. Broad St.
TULSA 3, OKLA., 307 East Brady St.
UTICA 1, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N. W.
WATERLOO, IOWA, 300 W. 3rd St.
WHEELING, W. VA., 1117 Main St.
WICHITA 2, KAN., 233 S. St. Francis Ave.
WILLIAMSPORT 1, PA., 348 W. Fourth St.
WILMINGTON 99, DEL., 216 E. Second St.
WORCESTER 4, MASS., 17 Mulberry St.
YORK 2, PA., 143 S. George St.

*Fully Equipped Sales Offices and Warehouses are maintained at all addresses.

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AKRON 8, OHIO, The Moock Electric Supply Co.
BIRMINGHAM 2, ALA., Moore-Handley Hdw. Co.
BLUEFIELD, W. VA., Superior-Sterling Co.
BUFFALO 2, N. Y., Buffalo Electric Co., Inc.
CANTON 2, OHIO, The Moock Electric Supply Co.
CHATTANOOGA, TENN., Mills & Lupton Supply Co.
CHICAGO 6, ILL., Hyland Electrical Supply Co.
DENVER 17, COLO., The Mine and Smelter Supply Co.
EL PASO, TEX., The Mine and Smelter Supply Co.
GRUNDY, VA., Buchanan-Williamson Supply Co.
HONOLULU, T. H., The Hawaiian Electric Co.
HUNTINGTON, W. VA., Banks-Miller Supply Co.
KANSAS CITY 8, MO., Columbian Elec'l Co.
KANSAS CITY 8, MO., Continental Elec. Co.
LEXINGTON 31, KY., Tafel Elec. & Supply Co.
LOUISVILLE 2, KY., Tafel Elec. & Sup. Co.
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ALLENTOWN, PA., H. N. Crowder, Jr., Co.
BATTLE CREEK, MICH., B. C. Electric Supply Co.
BECKLEY, WEST VA., Beckley Machine & Elec. Co.
BLOOMSBURG, PA., E. R. Beers Electric Co.
BRIDGEPORT, CONN., Sprague Electric Supplies, Inc.
BRISTOL, VA., Service Appliance Co.
COLUMBUS, GA., Columbus Iron Works Co.
EASTON, PA., H. N. Crowder, Jr., Co.
FALL RIVER, MASS., Smith Electric Supply Co.
FT. WAYNE 2, IND., The National Mill Supply Co.
HARLAN, KY., Kentucky Mine Supply Co.
HARTFORD, CONN., Electrical Supplies Inc.
KNOXVILLE, TENN., Roden Electrical Supply Co.
MOBILE, ALA., McGowin Lyons Hdw. & Supply Co.
MUSKEGON, MICH., Industrial Electric Supply Co.
PLATTSBURGH, N. Y., Plattsburgh Electric Supply Co.
ROCKFORD, ILL., Forest City Electric Supply Co.
SAGINAW, MICH., J. Geo. Fischer & Sons Inc.
SOUTH BEND 4, IND., The McCaffery Co.

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See Your Classified Telephone Directory for Other Westinghouse Distributors

Printed in U.S.

. . . also marked the start of TOLEDO Leadership in Pipe Tools!

● It was a big forward step in 1902 . . . when our country bought the rights and franchises for the Panama Canal from France. This greatly strengthened our growing leadership in world commerce and world affairs.

It was also in that same year—44 years ago—that a new name in Pipe Tools was born. With a modest start in small factory quarters . . . this was the beginning of TOLEDO Leadership as producers of Pipe Tools of outstanding Accuracy and Quality.

Through the years . . . the name TOLEDO has been a familiar symbol of dependability and long-life economy among pipe mechanics in all fields. It's the name you can trust today *and tomorrow!* The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.

TOLEDO

PRECISION PIPE TOOLS

The first TOLEDO Catalog published in August 1902 was 12 pages size 3" x 6" showing 4 tools —Models 1, 1A, 2 and 3. Our catalog today requires 60 pages size 8½" x 11" to describe the many models in the complete Toledo line.

"TOLEDO"

HOW WESCO *Service* WORKS FOR YOU!

WHEN you pick up your telephone and call your local Wesco office, a great many varied and essential services are immediately placed at your command. As a national electrical distributing organization with a network of 94 offices stretching from coast to coast, Wesco does more for you than simply act as a reliable source of supply for thousands of products. It assures you of services that often mean savings of your time, money and effort.

1. SALES AND ENGINEERING—Trained Wesco sales and engineering personnel are always available to help, advise and recommend. This sales and engineering service will assist you in making up bills of materials and will aid in bidding on jobs. These men have behind them a wealth of experience and training as well as extensive reference files of product information and technical data.

2. WAREHOUSING—The national network of 94 Wesco offices is in effect one large warehouse making available to you every one of the thousands of products made by hundreds of manufacturers scattered all over the country. Stocks in several Wesco warehouses will be pooled to fill very large or "hurry-up" orders. A perpetual inventory record system assures that your needs will be anticipated.

3. DELIVERY—There is a Wesco office conveniently near you to offer prompt, overnight delivery of "everything electrical". All parts of an order are assembled in one shipment. You receive *one* shipment, from *one* supplier, on *one* bill.

4. PURCHASING—By buying large quantities of products, Wesco is able to maintain substantial inventories from which your most exacting requirements are satisfied. Credit is extended to help finance jobs.

5. EXPERIENCE—Wesco salesmen are trained, seasoned men who have had years of practical experience. Working with them are engineers of manufacturers whose products Wesco distributes to crack the specialized jobs. A corps of Wesco specialists is also available to help you solve specific problems. They will cooperate in the application of new products, in quoting national or local codes and rulings, in arranging emergency service, in working up plans and specifications. They are there to serve you—you can rely on their thorough-going know-how.

Westinghouse Electric Supply Company

Phone the Office nearest you

94 WESCO offices are waiting to serve you with

WHAT YOU NEED
WHEN YOU NEED IT
WHERE YOU NEED IT
FROM ONE SOURCE OF SUPPLY

Here are a few groups of the more than 50,000 items carried in Wesco stocks. Your Wesco salesman and Wesco specialist are ready to help you in their sound application to your needs. To phone the Wesco office nearest you, see the complete listing of the 94 Wesco offices below.

Arresters—lightning

Boxes—floor, junction, cutout

Breakers—air, branch, oil

Cable—flexible, steel armored, non-metallic sheathed

Conduit—fibre, flexible, rigid

Connectors—solderless

Cord—heavy duty, rubber

Fans—attic, desk, bracket

Fittings—conduit types

Fixtures—airport, fluorescent

Fuses—cartridge, plug, link

Heaters—industrial, space, unit

Insulators—glass, porcelain, strain

Lamps—bactericidal, fluorescent, mercury, vapor, standard incandescent

Meters—demand, power factor, watt

Motors—AC squirrel-cage, synchronous, DC fractional horsepower, gear, splash-proof, totally enclosed

Panelboards—hazardous location

Receptacles—flush, porcelain, convenience, weatherproof

Reflectors—showcase, show window

Refrigerators—commercial

Sockets—brass shell, composition medium, series street, weatherproof

Starters—fluorescent lamp

Switches—float, toggle, entrance, disconnect, safety

Tapes—asbestos, cotton, fish, rubber, adhesive, varnished

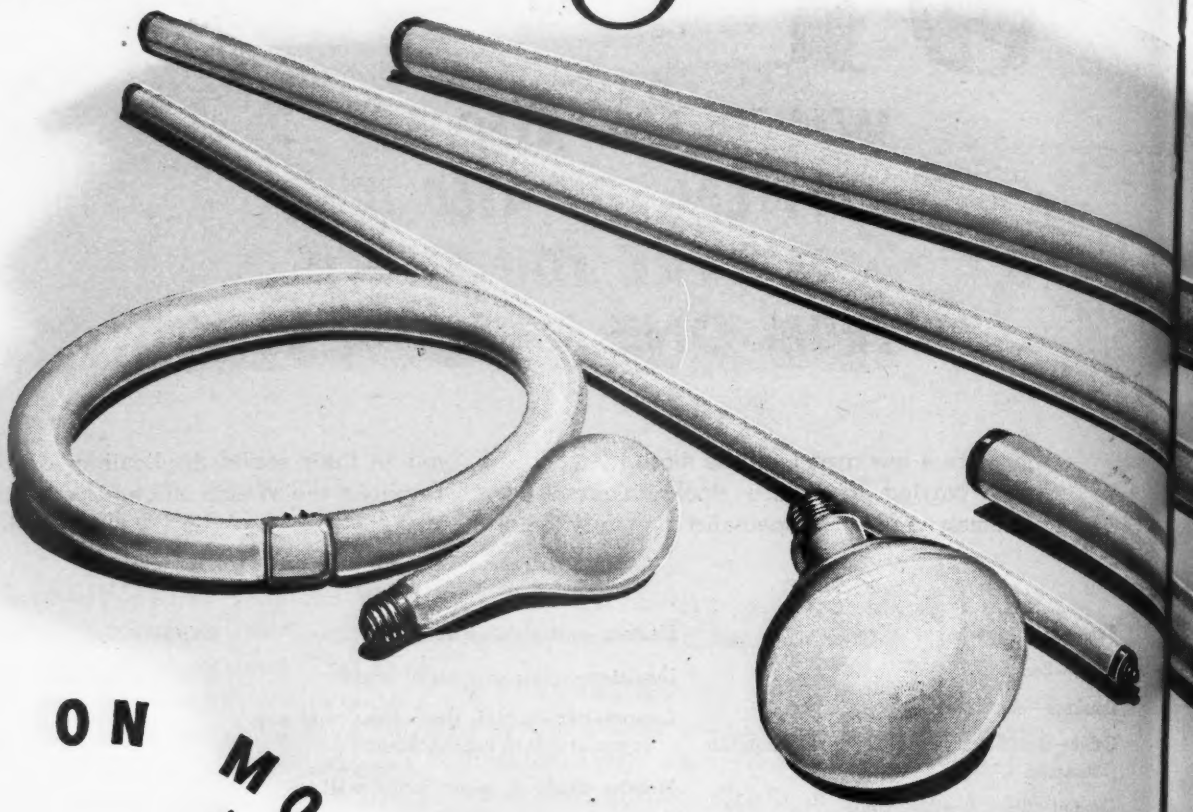
Transformers—auto, instrument, power, mercury lamp

Tubes—electronic

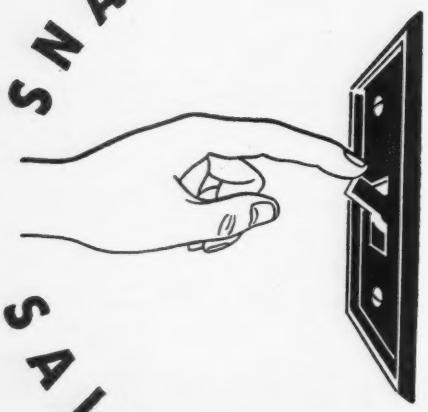
Wire—asbestos-covered, braided and lead sheathed, rubber covered

Albany	4-9135
Allentown, Pa.	5105
Beaumont, Texas	1744
Atlanta, Ga.	Atwood 2721
Amarillo, Texas	26535-37
Augusta, Me	2040-1
Baltimore, Md.	Plaza 0300
Bangor, Me.	6487
Binghamton, N. Y.	4-1364
Boston, Mass.	Hancock 7800
Brooklyn, N. Y.	Ma 2-8810
Burlington, Vt.	1924-25
Butte, Mont.	2-1269
Charlotte, N. C.	3-7518
Charleston, S. C.	4053
Chicago, Ill.	Haymarket 2540
Cincinnati, Ohio	Woodburn 7200
Clarksburg, W. Va.	440
Cleveland, Ohio	Henderson 6000
Columbus, Ohio	Maine 5571
Columbia, S. C.	8145
Corpus Christi, Texas	2-3351
Dallas, L. D.	489 C-2401-2-3-4-5
Davenport, Iowa	3-9966
Dayton, Ohio	Fulton 3131
Des Moines, Iowa	4-8134
Detroit, Mich.	Madison 8450
Duluth, Minn.	Melrose 6375
Erie, Pa.	26-853
Evansville, Ind.	7276
Flint, Mich.	4-8623
Ft. Wayne, Ind.	Anthony 3421
Ft. Worth, Texas	2-1107-8
Grand Rapids, Mich.	9-3103
Greenville, S. C.	3930-1
Green Bay, Wis.	Adams 783
Hempstead	Hempstead 1816
Houston, Texas	Capital 7272
Indianapolis, Ind.	Market 3301
Jamaica	Jamaica 6-4202
Jacksonville, Fla.	5-7246
Little Rock, Ark.	5154
Los Angeles, Calif.	Vandike 1381
Madison, Wis.	Badger 4990
Memphis, Tenn.	8-4196
Miami, Fla.	3-7431
Milwaukee, Wis.	Daley 1800
Minneapolis, Minn.	Bridgeport 4137
Newark, N. J.	Mitchel 2-3450
New Haven, Conn.	5-5154
New Orleans	Bywater 1661
New York	Walker 5-6000
Norfolk, Va.	2-2366
Oakland Cal.	Glencourt 6845
Oklahoma City, Okla.	2-7101
Omaha, Neb.	Jackson 4674
Peoria, Ill.	3-5111
Philadelphia, Pa.	Walnut 8950
Phoenix, Ariz.	4-2144
Pittsburgh, Pa.	Atlantic 9100
Portland, Ore.	Atwater 6411
Providence, R. I.	Gaspee 6484-5-6-7
Raleigh, N. C.	2-0541-2
Reading, Pa.	7236
Richmond, Va.	2-9071
Roanoke, Va.	7771
Rochester, N. Y.	Monroe 1635
Sacramento, Cal.	2-0229
St. Louis, Mo.	Central 4838
St. Paul, Minn.	Garfield 7441
Salt Lake City, Utah	5-2972
San Antonio, Texas	C-6216-C
San Francisco, Cal.	Garfield 4120
Savannah, Georgia	3-6382
Seattle, Wash.	Elliot 7001
Sioux City, Iowa	5-7634
Spokane, Wash.	Main 3281
Springfield, Mass.	4-3101
Syracuse, N. Y.	2-6158
Tacoma, Wash.	Main 4134
Tampa, Fla.	M-5595
Toledo, Ohio	Main 8101
Trenton, N. J.	6122-3-4
Tulsa, Okla.	37155-6-7-8
Utica, N. Y.	4-1194
Washington, D. C.	National 9700
Waterloo, La.	4679
Wheeling, W. Va.	3980
Wichita, Kan.	3-8215
Williamsport, Pa.	2-6184
Wilmington, Del.	6104
Worcester, Mass.	3-7238
York, Pa.	5569
Watertown, N. Y.	1400

A Westinghouse



SNAP ON MORE SALESMANSHIP



FLUORESCENT

First choice for over-all store lighting, fluorescents are being used more and more. And more and more people who deal with lighting depend on the name Westinghouse as assurance of peak efficiency.

INCANDESCENT

For dramatizing, spot-lighting, or supplementing other light, incandescent fills the bill. Westinghouse floods and spots with built-in reflectors, for example, are simple to use and inexpensive.

SLIMLINES

These fascinating long, slim tubes of fluorescent are ideal for showcase and architectural lighting. Lengths: 42, 64, 72, and 96 inches!

CIRCLINES

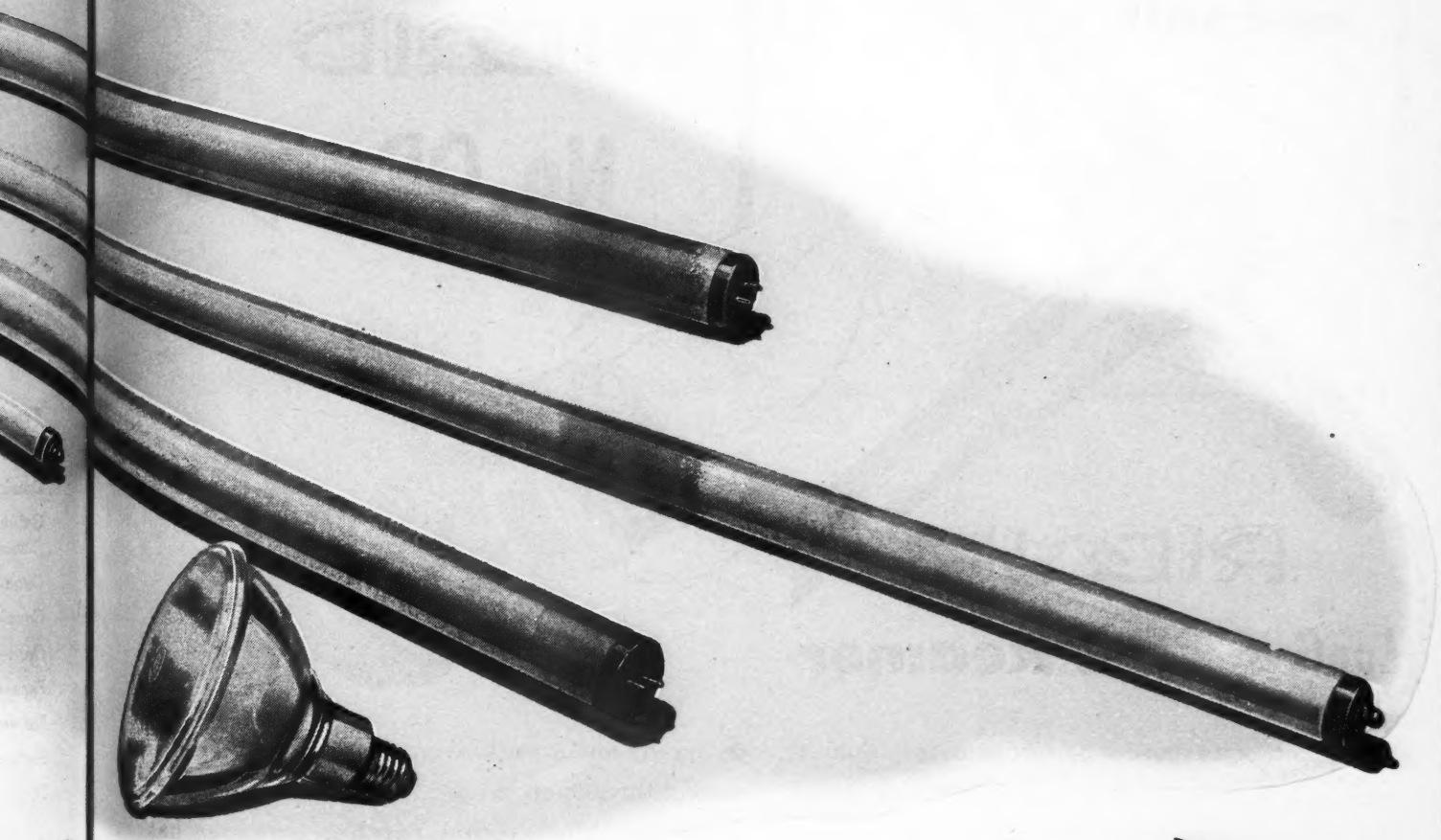
Put a halo around your product with these new fluorescents bent into circles. Think of the exciting new decorative effects they make possible for stores and displays.

Westinghouse

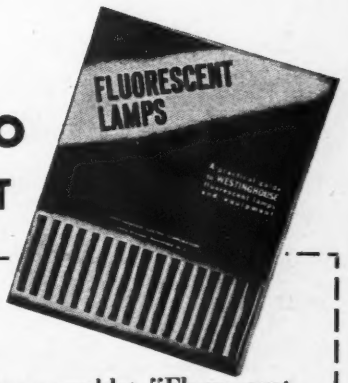
PLANTS IN 25 CITIES · OFFICES EVERYWHERE

LAMPS FOR SEE-ABILITY

LAMP FOR EVERY TYPE OF STORE LIGHTING



FREE... A NEW PRACTICAL GUIDE TO FLUORESCENT LAMPS AND EQUIPMENT



Westinghouse offers you a free copy of "Fluorescent Lamps," Form A-4759—a new 24-page pamphlet of helpful information about fluorescent lamps and their use. Westinghouse Electric Corp., Lamp Division, Bloomfield, New Jersey.

SEND FOR YOUR COPY TODAY

Westinghouse Electric Corp.
Lamp Division, Bloomfield, N. J.

Please send me a copy of your new free pamphlet, "Fluorescent Lamps," Form A-4759.

Name_____

Address_____

City_____ State_____

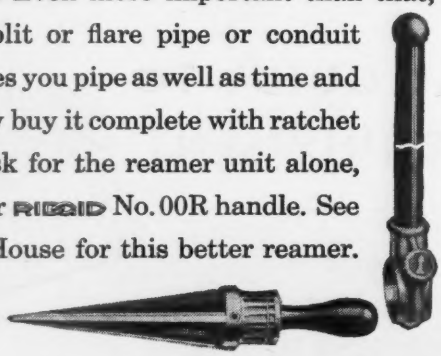
EC-9

This extra-long taper makes your pipe reaming quick, easy and safe

RIDGID

LonGriP Pipe Reamer

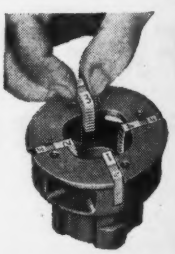
● The trick of its efficient performance is in that extra long taper—it reams burr cleanly from any pipe in a few easy ratcheted strokes—practically no pressure required. Even more important than that, it won't thin, split or flare pipe or conduit wall. That saves you pipe as well as time and work. You may buy it complete with ratchet handle—or ask for the reamer unit alone, which fits your RIDGID No. 00R handle. See your Supply House for this better reamer.



Reamer unit fits RIDGID No. 00R handle.

You thread small pipe with least effort with this tough little RIDGID No. 0R

● Speedy and a worksaver, when you want to cut perfect threads on ⅛" to 1" pipe. This smart steel-and-malleable internal ratchet threader has precision-made heat-treated tool-steel dies, each factory tested . . . for smooth fast threading. Die heads snap in from either side, can't fall out. No special dies needed for close-to-wall work. No. 0R, ⅛" to 1"; No. 11R, ⅛" to 1¼." You'll like these durable efficient RIDGIDs for small pipe. Ask your Supply House.



Chasers easily reverse for close-to-wall threads.

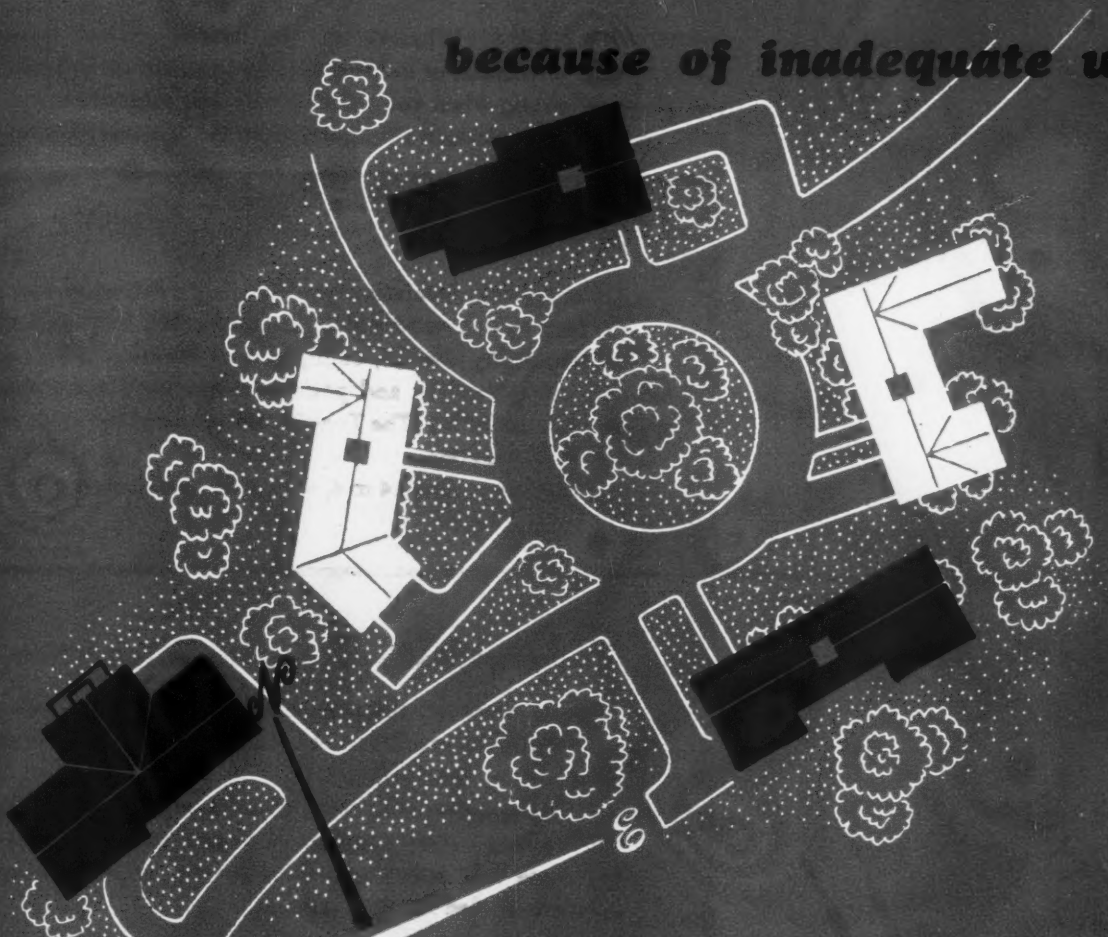
Millions of RIDGID Tools in use

RIDGID

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.

WARNING will 3 out of 5 be built obsolete because of inadequate wiring?



AN IMPORTANT MESSAGE TO ELECTRICAL CONTRACTORS

Right now, you have a great opportunity to help solve the housing problem *soundly*—and to do so with well-justified benefit to your business. It's like writing yourself an order for more jobs.

Americans need homes built for *modern living*, yet many of the modern-looking homes now proposed will be *obsolete when built*, because the *wiring plan* is not suited to electrical requirements.

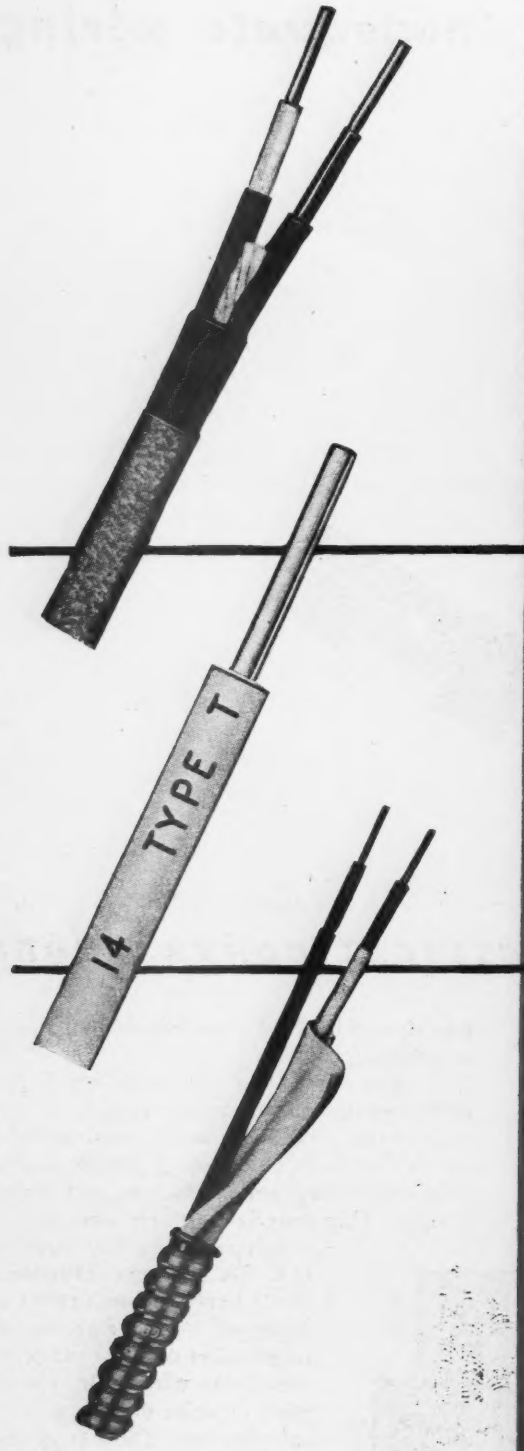
Your help is needed to give *adequate wiring* the importance it deserves . . . to impress householders, architects, and builders alike, with the gains in *livability* and *salability* that come with a careful layout of high-capacity circuits to meet tomorrow's electrical needs. Planners and builders of industrial and commercial buildings, too, should be shown the valuable advantages of adequate wiring.

In this effort, you can count on G.E. to team up with you. We are offering, in national, architectural, building, and industrial advertising, booklets and wiring guides that sell *adequate wiring*, and stress *your part* in doing it right. This material can help you, too.

Keep in touch with your local G-E Merchandise Distributor. He'll keep you informed and equipped with G-E ammunition to get more new buildings more effectively wired. Or, you may wish to write directly to us for information. (See page 6 of this insert for descriptions of informative literature.) Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Conn.

GENERAL ELECTRIC

wiring materials



WIRE AND CABLE—Whatever the job calls for—open or concealed wiring, residential or industrial, large installations or small—you won't go wrong when you use G-E wire and cable throughout. Here are a few representative products from the *full line:*

*PVX**

Thermoplastic insulation provides high dielectric and mechanical strength in this non-metallic sheathed cable. It is unusually resistant to oils, acids, alkalies, sunlight, and abrasion. PVX strips easily, and its lightweight and positive conductor identification facilitates speedy installation. The Type T conductors of this cable are approved for 60 C operation.

Available in sizes 14 to 4, with 2 or 3 conductors.

Thermoplastic Building Wire (Types T and TW)

A small diameter, thermoplastic-insulated wire, produced to most rigid specifications. It can be used for all wiring requirements where permitted by local codes.

It resists flame, oils, acids, alkalies, and other chemicals and solvents, and is virtually unaffected by sunlight, moisture, and weathering. Type T is recommended for general-purpose wiring. Type TW is recommended for wet locations.

BX Armored Cable*

This armored cable is extremely flexible for easy handling. It resists moisture and is flame-retardant for extra safety. An added feature is the S-shaped paper wrap, which is quick and easy to remove, and gives added protection. Available in all standard sizes, in 2, 3, and 4 conductors. Also in 2- and 3-conductor leaded cable, and bare armored ground wire.

*Trade-mark Reg. U. S. Pat. Off.

The full line also includes

SERVICE ENTRANCE CABLES • SERVICE DROP CABLES • FLAMENOL* CORDS • RUBBER-JACKETED CORDS
TELEPHONE WIRE • RIP CORDS • BUS DROP CABLES • WIRES AND CABLES FOR ALL TYPES OF SERVICE

(See page 6 of this insert for aids to wire and cable sales)

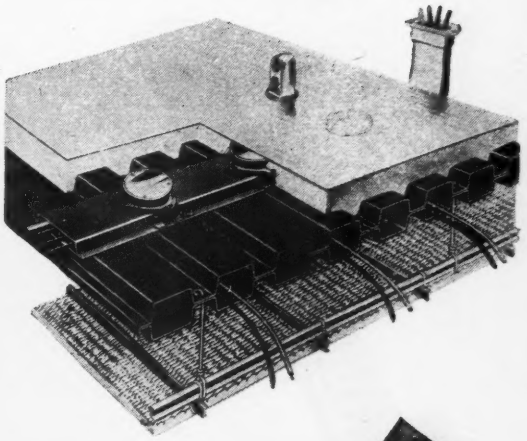
INSTALL A *full line!*

CONDUIT PRODUCTS — G. E. makes all types of conduit products, using the finest quality materials. They are designed to afford permanent protection under a great variety of service conditions. Typical of the *full line* are the products listed here:

G-E Q-Floor Wiring

Q-Floor wiring, used in conjunction with the cellular steel members of Robertson Q-Floors, results in an extremely simple and flexible method of supplying the electrical requirements of office buildings, banks, hospitals, and industrial plants which require a number of services and 100 per-cent electrical availability.

Q-Floor wiring permits the installation of outlets anywhere in the floor, on 6-inch centers.



G-E Fiberduct

This underfloor raceway system for wood and concrete floors provides fully adequate electrical service in many types of building construction. The Fiberduct system consists of (1) a non-metallic raceway made of corrosion-resistant impregnated fiber; (2) single-, double-, or triple-duct, cast-metal junction boxes; (3) duct fittings that form part of the raceway, such as couplings, crossunders, supports, conduit adapters, etc.; and (4) a complete line of outlet or surface fittings.

Rigid Conduit

G-E Black Conduit has an asphaltic-base, baked-enamel coating which effectively protects the conduit from chemical liquids, acids, fumes, oil, and other conditions that cause chemical corrosion.

G-E White Conduit is hot-dipped zinc-coated to provide permanent protection from the corrosive effects of heat, cold, sunlight, condensation, and other atmospheric conditions.

GENERAL ELECTRIC

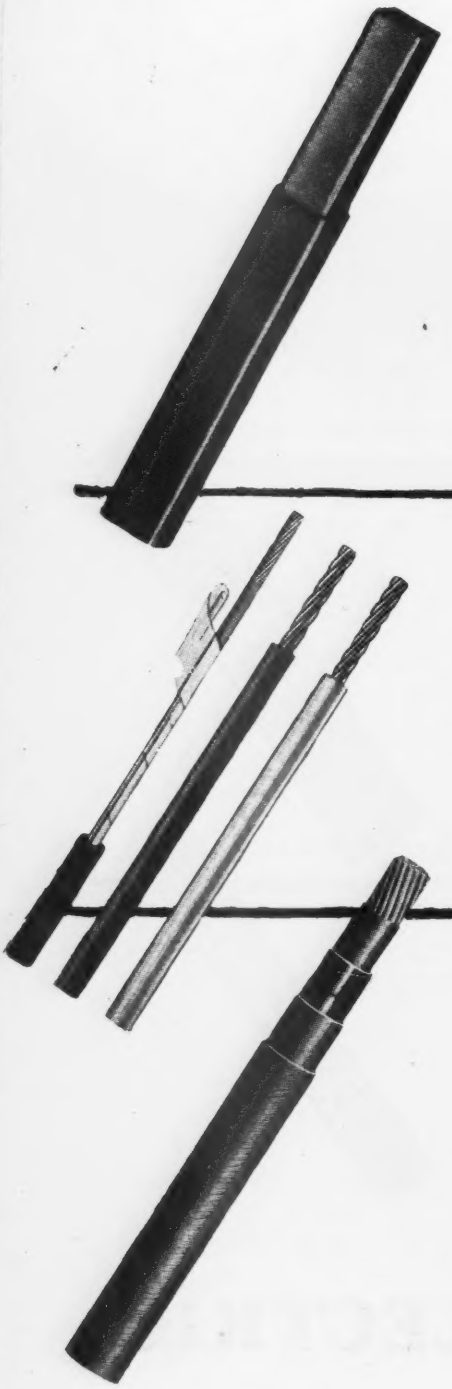
The full line also includes:

ELECTRICAL METALLIC TUBING • FLEXIBLE CONDUIT • EXPLOSION-PROOF CONDUIT • OUTLET AND SWITCH BOXES • COVERS • HANGERS • ALL FITTINGS AND COMPONENT PARTS

(See page 6 of this insert for aids to conduit products sales)

GE wiring materials

DELTABESTON* WIRES AND CABLES—Those installations that require something extra in heat resistance are best made with wires and cables from Deltabeston's *full line:*



Deltabeston Magnet Wire

These wires are made in square, rectangular, or round cross-sections in a full range of sizes. They will take baking and bonding without weakening, and will stand up for years under heat, oil, or moisture. They may be formed into intricate shapes without cracking or bending. Used for operating temperatures up to and above the 125 C rating for Class B insulation.

Deltabeston Appliance Lead Wire

Felted asbestos impregnated with a heat-resistant bonding agent provides a strong, durable insulation for these lead wires. Range wire, electric stove wire, and appliance lead wire are part of the *full line*. They are available with copper or nickel conductors with smokeless or moisture-resistant insulation. The wire can be bent acutely without weakening the insulation, and ends strip freely without fraying.

Deltabeston Power Cable

Recommended for wiring in boiler rooms, power plants, steel mills, and other locations where heat and corrosive vapors are encountered. The insulation resists heat, flame, moisture, oil, and corrosive vapors. Types available for many different service conditions, in exposed installations or conduit.

Cables for special service or unusual applications are made to customer's specifications.

*Trade-mark Reg. U. S. Pat. Off.

The full line also includes:

AIRCRAFT WIRE • ELECTRONIC WIRE • CORDS • FIXTURE WIRE • SWITCHBOARD WIRE • STATION CONTROL CABLE • APPARATUS CABLE • OTHER SPECIAL TYPES

(See page 6 of this insert for aids to Deltabeston wire and cable sales)

INSTALL A *full line!*

WIRING DEVICES — G-E wiring devices serve all residential, industrial, and commercial requirements. The *full line* includes a wide range of types, sizes, and capacities:

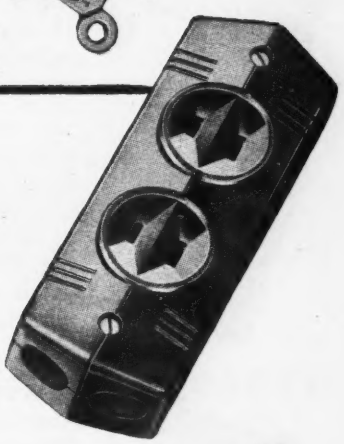
G-E Silent Switches

These new silent mercury switches provide noiseless operation in bedrooms, nurseries, and other locations where quiet and tranquility are desirable. They are hard to beat for long life, because there are fewer moving parts to get out of order. Conventional blades and springs are eliminated. A hermetically sealed "mercury button" actuates the make and break silently and efficiently.

Surface Wiring Devices

New wiring or wiring extensions in farm buildings, industrial plants, warehouses, garages, and many other types of construction can be installed quickly and economically with these devices.

Light, strong, and convenient, they keep their color, and resist moisture and corrosion. They will accommodate either No. 12 or No. 14 two- or three-conductor cables. The *full line* includes switches, lampholders, convenience outlets, and junction boxes.



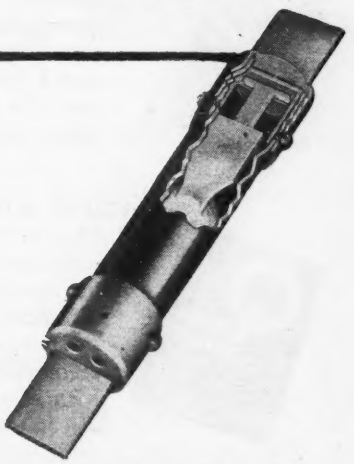
Silvend Fuses*

G-E Silvend fuses are especially desirable for use in industrial plants where reduction of maintenance time is important.

The silver-plated contact surfaces of G-E Silvend fuses maintain good electrical contact as long as the fuses stay in service. There is no heating due to oxidation to cause premature blowing.

For your every fuse requirement, G-E offers Pyrex* plug fuses, renewable fuses, non-renewable fuses, and Fustats.

*Trade-mark Reg. U. S. Pat. Off.



GENERAL ELECTRIC

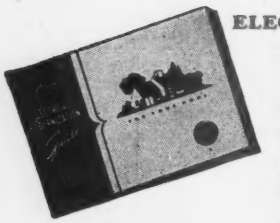
The full line also includes:

LAMPHOLDERS • STANDARD SWITCHES • CONVENIENCE OUTLETS • HEAVY-DUTY SWITCHES
FLAMENOL* CORD SETS • PLATES • COMBINATION DEVICES • PLUGS • FLUORESCENT ACCESSORIES

(See page 6 of this insert for aids to wiring devices sales)

G-E offers these valuable aids to full line sales

Check the materials you need, and ask your nearest G-E Merchandise Distributor to supply you, or write Section X2-98, Appliance and Merchandise Department, General Electric Co., Bridgeport 2, Conn.



ELECTRICAL MODERNIZATION GUIDE

This new booklet will help your customers remodel their homes for modern electrical living. Profusely illustrated and easy to understand, it points out the many advantages of adequate wiring — how easily and inexpensively it can be achieved. A big foot in the door to more sales.

FARM WIRING GUIDE

Every one of its 54 pages is packed with ideas to help you get a big share of the booming market for farm wiring. Good for your customers, too, as an eye-opener to the benefits of electricity on the farm.

ADEQUATE WIRING FOR INDUSTRY

Use this comprehensive manual as a basis for suggesting worthwhile improvements in the wiring systems of your industrial customers. Contains useful facts and figures to help you give the type of service that builds good will — and sales.

Q-FLOOR WIRING

This attractive booklet contains descriptions of Q-Floor Wiring and fittings for Robertson Q-Floors, with technical data, layout design suggestions, specifications and installation recommendations. Contains the information you need when you go after those underfloor wiring jobs.

NEW G-E FUSE CATALOG.

Contains complete data on G-E cartridge fuses and plug fuses, as well as valuable general fuse information. Helps you to service the fuse needs of many different wiring systems.

G-E FIBERDUCT

G-E Fiberduct for underfloor wiring of wood or concrete floors provides unusually good electrical flexibility in many types of construction. This 36-page catalog gives facts and data that will help you get these jobs.

DELTABESTON* WIRE AND CABLE

A comprehensive, 94-page book containing descriptions, technical data, specifications, and other information on Deltabeston power cables, magnet wires, switchboard wires, appliance wires, boiler room wires and cables, and many more types.

OTHER HELPFUL LEAFLETS

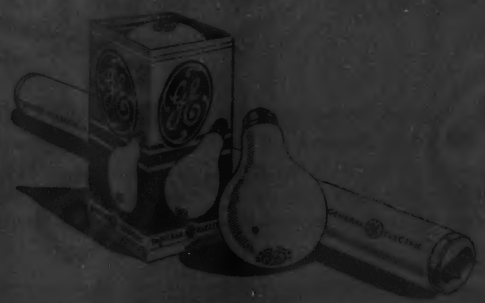
Handy descriptions of Flamenol* cords for industrial use, G-E thermoplastic building wires, conduit products, Silvend* fuses. Leaflets available for other G-E wiring products.

These booklets, and others not shown here, have been prepared to help you sell General Electric's full line of electrical products for all types of construction. Your local G-E Merchandise Distributor or G-E field representative is always ready to help you — by furnishing sales ammunition, by answering your questions, by suggesting "business-getters." We want you to call him in often.

*Trade-mark Reg. U. S. Pat. Off.

GENERAL ELECTRIC

G-E's KEY PLAN for the KEY MAN



How we can make it easier for contractors to plan and specify lighting jobs

AS THE KEY MAN on most lighting projects, Mr. Contractor, you're usually in on every step of a job, from the time it's a 1-watt gleam in your salesman's eye until the installation is complete. And we realize that the handling of details—particularly making up specifications—can be quite a problem.

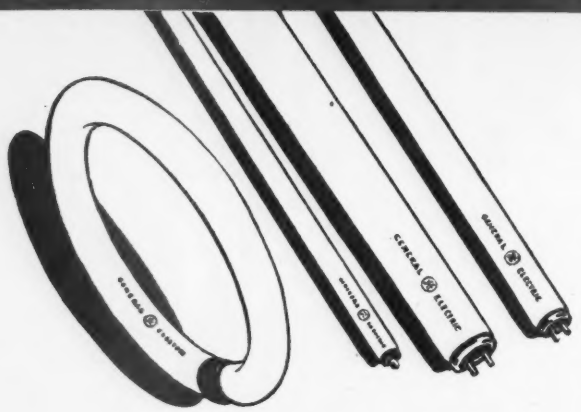
G-E HAS A KEY PLAN to make your specification job simpler—to make it easier for you to work closely with the rest of the lighting team—the architect, the utility engineer, the fixture maker and the electrical wholesaler. It's a plan you can use every day to capitalize on the latest developments in commercial, industrial and home lighting.

G-E'S KEY PLAN FOR THE KEY MAN

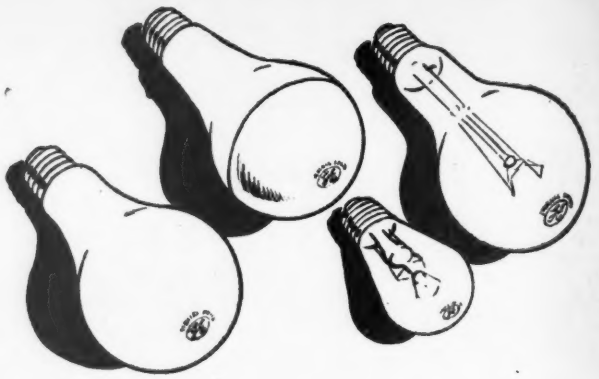
brings you these three important advantages:

1. **COMPLETE LINE OF LAMPS**
2. **COMPLETE WORKING INFORMATION**
3. **CONVENIENT LOCAL SERVICE**

1. Whatever Lamps you need..

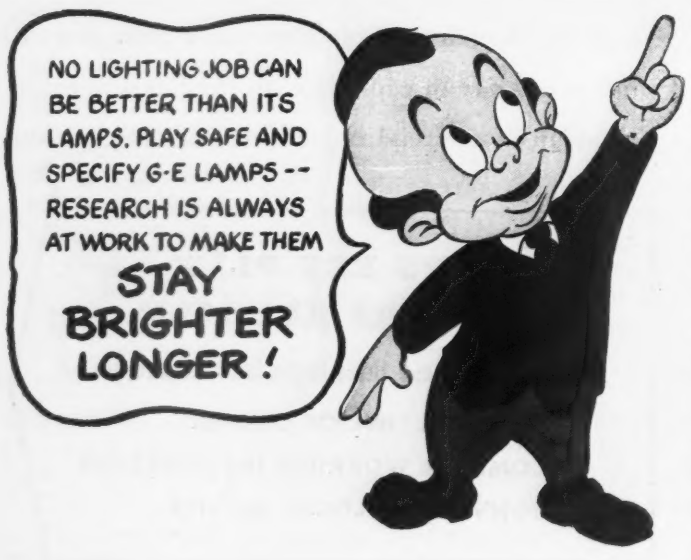


COMPLETE FLUORESCENT LINE, including standard lamps from 14 to 100-watts, in 3500 white, 4500 white, 6500 daylight and colors. The G-E slimline ranges from 42 to 96 inches in length, ¾ to 1 inch in diameter; instant-starting, with single-pin base. G-E circline is now manufactured in the 32-watt size with 12 inch diameter. 8¼ and 16 inch sizes will soon be in production.



G-E FILAMENT LAMPS for general lighting jobs are made in sizes from 6 to 1500-watts; candelabra, intermediate, medium or mogul screw bases, or bi-post base in certain sizes. Standard lamps operate on 115, 120 volt circuits. Others made for 230 and 250-volt circuits and for low voltage farm service.

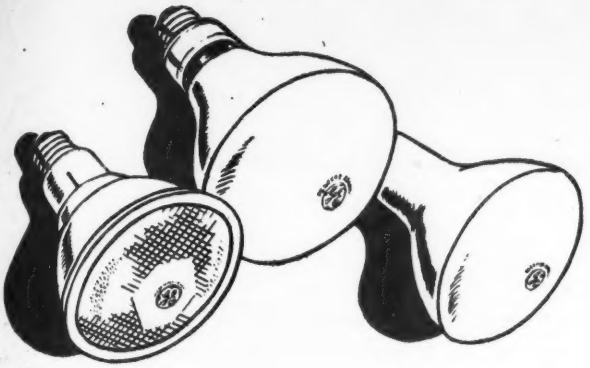
2. It's easy to get full working



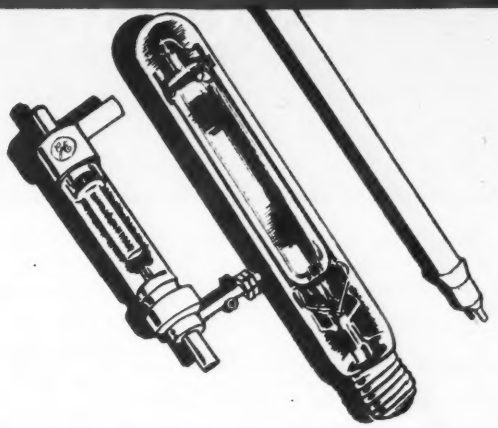
SPECIAL CONTRACTOR PROGRAMS. Through specially prepared programs of local meetings presented throughout the country, G-E Lamp men are constantly at work bringing contractors practical information on ways to develop profitable lighting business. Don't miss G-E's new Store Lighting Meetings, now being held! This fast-moving program is crammed with facts, figures and ideas to help you sell more commercial lighting...and it includes all the actual booklets, sales letters and other selling tools you'll need to close more business.

HELPFUL LITERATURE. And here's a list of basic G-E Lamp publications offering a wealth of easy-to-use facts and figures to help you plan and specify various types of lighting jobs. To get your copy of any booklet listed, just call your G-E Lamp representative or contact any General Electric Lamp Department District Sales Office (turn the next page for address).

G·E MAKES 'EM ALL!



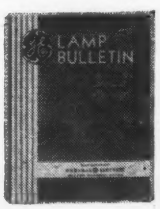
G-E REFLECTOR AND PROJECTOR LAMPS offer a wide selection of concentrated and wide-spread floodlighting beams. Reflector spot lamps serve to highlight store displays. Reflector flood lamps ideal for overall emphasis lighting. Both serve similarly in outdoor uses.



G-E MERCURY LAMPS are an excellent choice for "high-efficiency" industrial lighting in high and medium-high bays. These arc-source lamps are made in 400, 1,000 and 3,000-watt sizes. The 1,000-watt (water-cooled) lamp is ideal for studios, photo-engraving plants and similar uses.

information on G·E Lamps

G-E LAMP BULLETIN (LD-1)—A 76-page illustrated textbook full of useful information on the design and operation of incandescent, mercury and fluorescent lamps. Features full-color spectral curves.



ESSENTIAL DATA FOR GENERAL LIGHTING DESIGN (Folder D)—Complete, condensed specification data, with diagrams and tables to simplify selection of lamps and fixtures. (6 pages.)

THREE A'S OF STORE LIGHTING (LD-7)—An elaborate, profusely illustrated 70-page textbook that tells you all you need to know to develop a profitable business in store lighting.

STORE LIGHTING LAYOUT AND DESIGN GUIDE (Form Y-5170-R)—A handy form developed especially by G-E to make it easier and faster for you to sit down with your customers and work out actual lighting layouts. (6 pages.)

LIGHT FOR LIVING (Y-566-R)—A 48-page idea and data book to help you work out the details of home lighting.

FLUORESCENT LAMPS AND AUXILIARY EQUIPMENTS (LS-101)—Condensed specification and price data on the complete G-E line. (6 pages.)

FLUORESCENT LIGHTING CALCULATOR (Y-1298R)—A pocket-size slide-rule to speed up the job of figuring the number of fixtures for any installation.

GERMICIDAL FIXTURES (LD-15 and LD-11)—Two booklets which together contain full information on the design, selection, installation and use of Germicidal Fixtures for air disinfection.

IN ADDITION to the literature listed above, G-E publishes useful booklets on all types of lamps for all types of lighting—including a series of 21 architectural booklets, publications on sports lighting, office lighting, school lighting, industrial lighting, and many others. Tell your General Electric Lamp representative the information you need, and he'll get it for you.

and Remember

3. G-E Lamp Service is as close as your telephone

The General Electric Lamp Department has a nation-wide network of 17 major sales and service districts in addition to lamp representatives in almost every major city. In each of these sales districts, highly trained lighting specialists and engineers are ready to bring you the very latest technical information and data developed by the research and engineering staffs of the General Electric Lamp Department in their laboratories at Nela Park, the lighting center of the world. General Electric district engineers with many years of field experience will gladly help you solve difficult problems on major installations. For the latest in lamps and lighting information, call your General Electric Lamp representative.

LAMP DEPARTMENT, GENERAL ELECTRIC COMPANY

Sales Districts	*Street Address*	*Telephone No.*
ATLANTA 3, GA.	187 Spring St., N. W.	WAlnut 9767
BOSTON 10, MASS.	50 High St.	HAncock 1680
BUFFALO 2, N. Y.	901 Genesee Bldg.	CLeveland 3400
CHICAGO 80, ILL.	842 So. Canal St.	HARrison 5430
CLEVELAND 14, OHIO	1320 Williamson Bldg.	CHerry 1010
DALLAS 2, TEXAS	1801 North Lamar St.	Central 7711
DENVER 2, COLO.	1863 Wazee St.	MAin 6141
DETROIT 26, MICH.	1400 Book Tower	CHerry 6910
KANSAS CITY 8, MO.	2100 Wyandotte St.	Victor 7671
LOS ANGELES 13, CALIF.	601 West Fifth St.	Michigan 8851
MINNEAPOLIS 13, MINN.	500 Stinson Blvd.	GRanville 7286
NEW YORK 22, N. Y.	570 Lexington Ave.	Wickersham 2-6300
OAKLAND 7, CALIF.	1614 Campbell St.	Highgate 7340
PHILADELPHIA 2, PA.	1405 Locust St.	KINgsley 3336
PITTSBURGH 22, PA.	535 Smithfield St.	GRant 3272
PORTLAND 9, ORE.	1238 N.W. Glisan St.	BEacon 2101
ST. LOUIS 1, MO.	710 No. Twelfth Blvd.	CHestnut 8920.

General Offices NELA PARK, CLEVELAND 12 OHIO

SWITCHBOARDS

Dead Front
- Shutlbrak
- Klampswitchfuz
- Circuit Breaker

Live Face

Stage and Auditorium Lighting Controls

PANELBOARDS

Lighting Panels
- Thermag Circuit Br.
- Dublbrak Circuit Br.
- Narrow Column
- Dust-tight
- Switch and Fuse

Power Panels
- Circuit Breaker
- Switch and Fuse

BUSDUCT

Feeder

Plugin

Wire and Cable Duct

SWITCHES

Shutlbrak (Enclosed)

Knife

LOAD CENTERS

(SERVICE EQUIPMENT)

Circuit Breaker

Switch and Fuse

HEATERS

QUIKHETER
- Built-in

OTHER PRODUCTS

Floor Boxes

Fan Hanger Outlets

FOR nearly sixty years Frank Adam Electric Company has been serving the light and power distribution and control needs of American Industry. Experience plus sound engineering and good workmanship has enabled this company to produce equipment that has met the highest standards of quality.

Whether it is a small Floor Box, Hanger Outlet, Quikheter or Load Center for the home, or a Switchboard, Panelboard, Busduct, heavy duty Switch or Service Equipment for industrial or commercial purposes, you can be assured of maximum dependability and trouble-free service when you specify Frank Adam.

Or, if the job is one that requires specialization, then consult one of the company's conveniently located district representatives. These men are qualified by training and experience to assist in planning and solving all technical application of (FA) Products. Their services are yours for the asking. Call one of them the next time you need practical advice on light and power distribution problems.

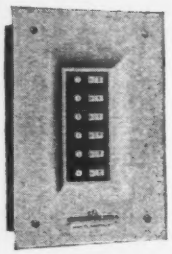
DISTRICT REPRESENTATIVES

ATLANTA 2, GA.	Herman Junghans	1820 Memorial Drive S. E., DEarborn 1315 (P.O. Box 4183)
BALTIMORE 11, MD.	Wolfe & Mann Mfg. Co.	28th and Sisson Sts., BElmont 8800
BOSTON, MASS.	J. J. Cassidy	72 Jacob St., Malden 48, Mass., MAlden 4334
BUFFALO 2, N. Y.	Hunter & Bell Co.	858 Main St., Elmwood 2210
CHICAGO 7, ILL.	Triangle Equip. Co., Inc.	610 W. Van Buren St., FRanklin 3630
CINCINNATI 2, OHIO	Miller Kleine	1303 Union Trust Bldg., MAin 5456
CLEVELAND 15, OHIO	R. F. Reske Agency	Room 606, 1900 Euclid Ave., CHerry 1373
DALLAS 1, TEXAS	P. A. Michler	1814 Irwin-Keasler Bldg., RIverside 5061
DENVER 2, COLO.	F. E. Staible & Sons	2046 Arapahoe St., TAbor 3991
DES MOINES 9, IOWA	Midwest Equipment Co.	908 Grand Ave., 3-5786
DETROIT 1, MICH.	J. P. Laughlin	3101 Brooklyn Ave., TEmple 1-0780
FLORIDA-CLEARWATER	F. C. Picker	606 N. Osceola Ave. (P.O. Box 264), 2742
HOUSTON 2, TEXAS	B. L. Winkler	730a M. & M. Bldg., Fairfax 6225
INDIANAPOLIS 4, IND.	Harry L. Dickinson	404 Merchants Bank Bldg., FRanklin 3688
KANSAS CITY 8, MO.	B. L. McCreary & Son	417 E. 18th St., VIctor 3504
LOS ANGELES 12, CALIF.	Zinsmeyer Co.	729 Turner St., MAdison 2191
MEMPHIS 3, TENN.	Lee B. Rosebrough	166 Monroe Ave., 5-1631
MINNEAPOLIS 2, MINN.	L. H. Cooper	220 Frontenac Bldg., ATlantic 2623
NEW ORLEANS 12, LA.	W. J. Keller	304 Natchez Bldg., MAgnolia 3603
NEW YORK 19, N. Y.	Fred G. Kraut	419 W. 54th St., Columbus 5-6861
OMAHA 2, NEB.	Midwest Equipment Co.	1112 Farnam St., ATlantic 7600
PHILADELPHIA 7, PA.	Wm. A. MacAvoy, Jr.	244 N. 10th St., Bell-Walnut 0550
PITTSBURGH 22, PA.	Crescent Sales Co.	298 DuQuesne Way, GRant 3833
ST. LOUIS 6, MO.	O. H. Rottmann	1023 N. Grand Blvd., JEfferson 7100
SAN FRANCISCO 9, CALIF.	Columbia Elec. Mfg. Co.	390 9th St., HEmlock 0064
SPOKANE 9, WASH.	A. F. Cook	818 Fourth St., MAin 1250
SYRACUSE 10, N. Y.	F. L. Grant	625 Cumberland Ave., 5-7448
TOLEDO 6, OHIO	Frank L. Lucas	2236 Hollywood Ave., GArfield 0227
TULSA 4, OKLA.	Paul E. Ebersole	214 S. Victor St., 3-9248

EXPORT REPRESENTATIVE

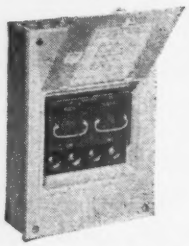
NEW YORK 7, N. Y.	Langguth-Olson Co.	11 Park Place, BArclay 7293

Ⓕ SERVICE EQUIPMENT



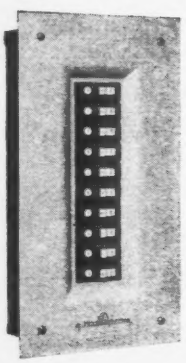
Ⓕ SERVICE EQUIPMENT

Ⓕ Type AC Circuit Breaker Service Equipment are the most modern method of circuit protection. Automatic trip on short circuits restores service with flip of handle. Nothing to replace. Ideal for homes. Furnished in six circuits and less, single and double pole, 15 to 50 amperes, 120 volt AC.



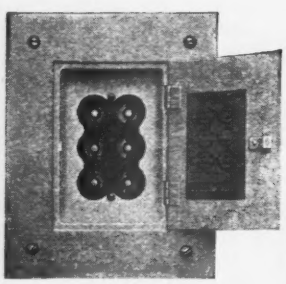
Ⓕ M-R UNIT

The new Ⓕ Main and Range Service Unit is designed specifically to meet the need for modern circuit protection for homes. Provides extra capacities for heavy appliances such as ranges, etc. Available in 60 amperes series and 100 amperes parallel main connections.



Ⓕ LOAD CENTERS

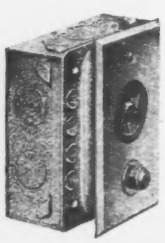
Ⓕ Type Circuit Breaker Load Centers or Service Equipment with 16 individual circuit breakers or less, all single pole, or combination of single and double pole to a maximum of 16 poles. Automatic Thermal-Magnetic trip for overloads and short circuits. Excellent for garages, stores, office buildings, schools, etc.



Ⓕ TYPE FBX FUSE BOX

A popular safety type made for 2 to 20 branch circuits.

All load centers and service equipment are code thickness furniture steel with rust-proof, pearl grey finish.



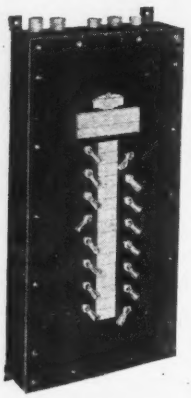
Ⓕ HANGER OUTLET

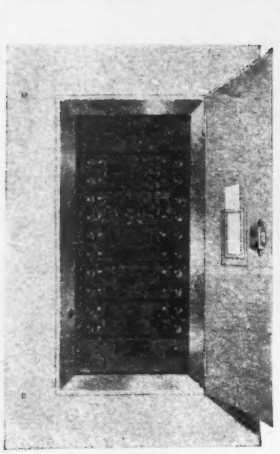
Built to hold heavy fans, Ⓕ Hanger Outlets can be used to support and supply service to electric signs, spotlights, radios, public address systems, etc. Outlet box is 4" square by 1½" deep. Plaster keys to prevent cracking, face plate 2½" x 4¼" made of brass, a brush finish. A similar unit for clocks is also available.

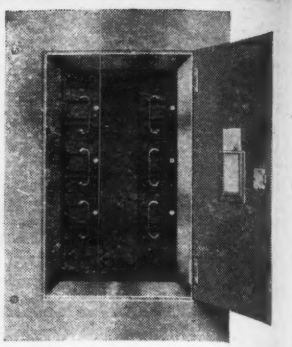
Ⓕ FLOOR BOXES

Ⓕ Floor Boxes provide safe and convenient outlets for telephones, signal systems, lighting and small electrical appliances. Adjustable. Leveling top permits smooth floor surface when unit is not in use.

Ⓕ PANELBOARDS Ⓕ







Ⓕ PULFUZSWITCH

Ideal for lighting and appliance feeder branches and power circuit branches. Switches are horsepower rated, pull-out type with pressure-locking fuseholders. Modern, safe, dependable and trouble-free. Capacities—30 to 100 amperes, 250 volts—and 30 to 60 amperes, 575 volts—2 and 3 pole service.

Ⓕ LNT1P — THE LEADER

Combination plug fuse and tumbler switch, four circuits to a section. 3 wire and 4 wire S/N mains. 30 ampere, 250 volt switches, 4 to 40 branches. Low cost and long service make it a "Leader" in fact and name.

Ⓕ DUST-TIGHT

Especially designed for use where dust is a hazard. Equipped with Thermag or Dublbrak circuit breakers, 4 to 42 circuit capacity, 50 amperes or less. Power panels: 15 to 600 amperes, 250 volts AC or DC, 600 volts AC.

Ⓕ COLUMN TYPE

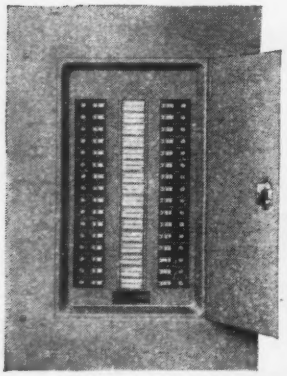
Built with standard Thermag or Dublbrak circuit breakers to fit 8, 9 or 10-inch H columns, between windows, or in any other narrow space. Eliminates long wiring runs and saves valuable floor and wall space.

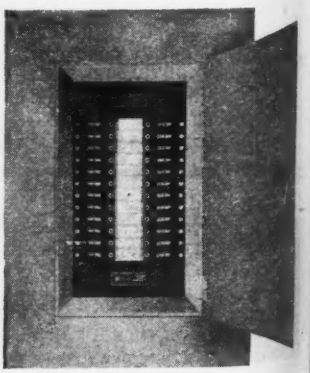
Ⓕ THERMAG

Type AC Circuit Breaker Panelboard with automatic Thermal-Magnetic disconnect. Positive protection against short circuit or overload. Sturdily constructed for industrial use in hotels, institutions and public buildings. 15 to 50 ampere capacity branches, 3 or 4 wire mains.

Ⓕ DUBLBRAK

Combines finest features of automatic thermal trip with fast double make and break connections. 15 to 50 ampere capacity branches, 4 to 42 branch circuits, 125 volts, AC or DC, 3 or 4 wire mains.



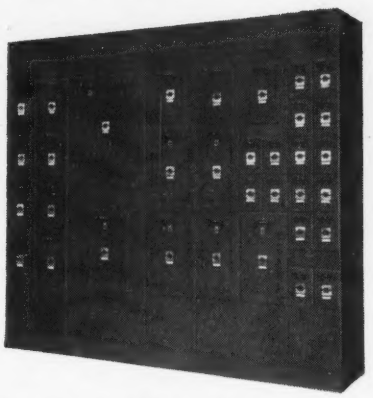


SWITCHBOARDS

The Frank Adam Electric Company has specialized in the manufacture of switchboards for commercial and industrial purposes and for stage lighting.

Quality workmanship and high standards of performance have made FA a symbol of the highest traditions in power and light control. Top ranking FA switchboards are the following:

FA KLAMPSWITCHFUZ



A safety type switchboard which combines both disconnect switch and fuse protection in one unit. Doors close in both "ON" and "OFF" position. Heavily silvered blades are held in contact which locks fuses at the same time. Capacities from 30 to 1200 amperes, 250 volts, AC or DC, and 30 to 600 amperes, 575 volts AC in 2, 3 and 4 poles.

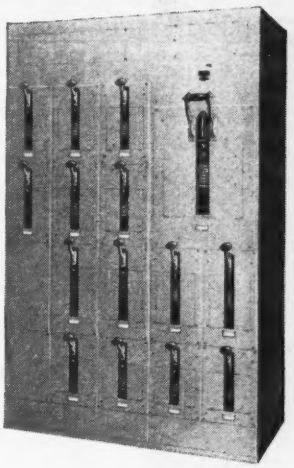
FA LIVE FACE

Made with standard FA knife switches with fuses on face of ebonized asbestos panel...or on separate panel at rear.

FA CIRCUIT BREAKER

Safety type switchboards, containing the latest developments in automatic protection of main and branch feeder circuits. Available in capacities up to 600 amperes, 250 volts AC or DC, and 575 volts AC, 2 or 3 pole.

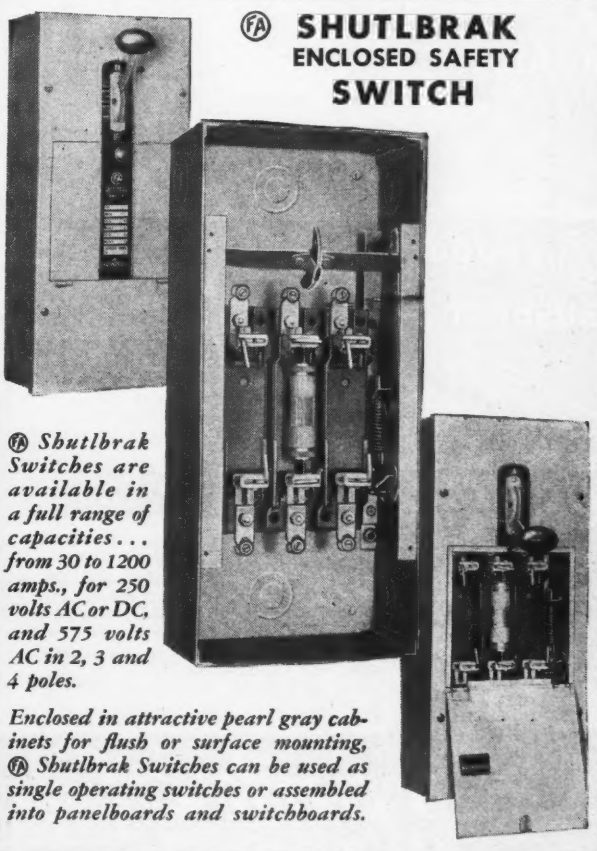
FA SHUTLBRAK



A safety type switchboard board designed for heavy use. Built with standard pre-assembled switching units with quick make and break contacts—interlocking cover permits access to fuse compartment only when switch is in "OFF" position. Capacities from 30 to 1200 amperes, 250 volts AC or DC, and 575 volts AC in 2, 3 and 4 poles.

The outstanding characteristic of these switchboards is the FA Shutlbrak Switch, illustrated below — a high quality, horsepower rated heavy duty industrial switch for motor control, service entrance or any job requiring an operating switch. This switch embodies a new switching principle — that of a shuttle movement, faster than the eye, within an insulated, dampproof chamber. New clamp type fuseholders and solderless pressure connectors assure years of trouble-free service.

FA SHUTLBRAK ENCLOSED SAFETY SWITCH



FA Shutlbrak Switches are available in a full range of capacities... from 30 to 1200 amps., for 250 volts AC or DC, and 575 volts AC in 2, 3 and 4 poles.

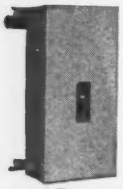
Enclosed in attractive pearl gray cabinets for flush or surface mounting, FA Shutlbrak Switches can be used as single operating switches or assembled into panelboards and switchboards.

FA PRODUCTS.. *The Sign of a Better Job*"

FA BUSDUCT FA

FA PLUGIN UNITS

Attractively finished in pearl gray enamel, FA Plugin units are designed to plug into any one of the standard outlets of FA Plugin Busduct and can be mounted on either or both sides of the section. Their rugged construction permits heavy usage.

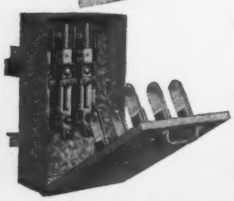


CIRCUIT BREAKER TYPE

Provides full automatic protection against short circuits and dangerous overload. Time-delay action prevents unnecessary interruption of service. Capacities 15-225 amp., 250 and 575 volts.

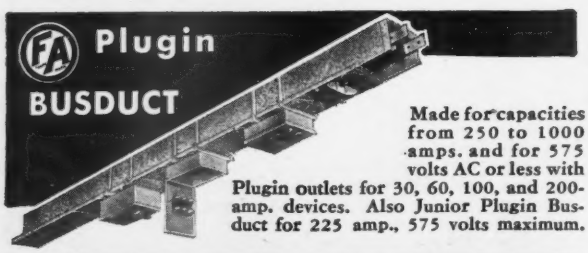
SHUTLBRAK TYPE

A heavy duty operating switch with quick make and break contacts. Includes FA Kamklamp fuse-holders and pressure type solderless connectors in a unit designed for safety and efficiency. Capacities: 30 to 200 amp., 250 and 575 volts.



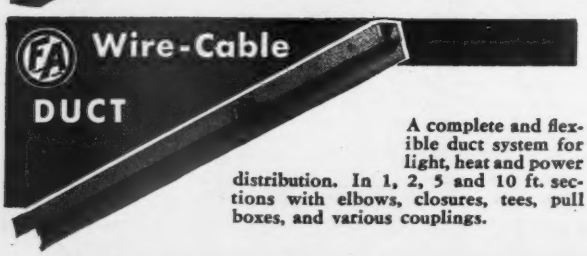
KLAMPSWITCHFUZ TYPE

Plugin Unit for disconnect service. The hinged-type pull out door contains both switch and fuse in one unit. Capacities: 30-200 amp., 250 and 575 volts.

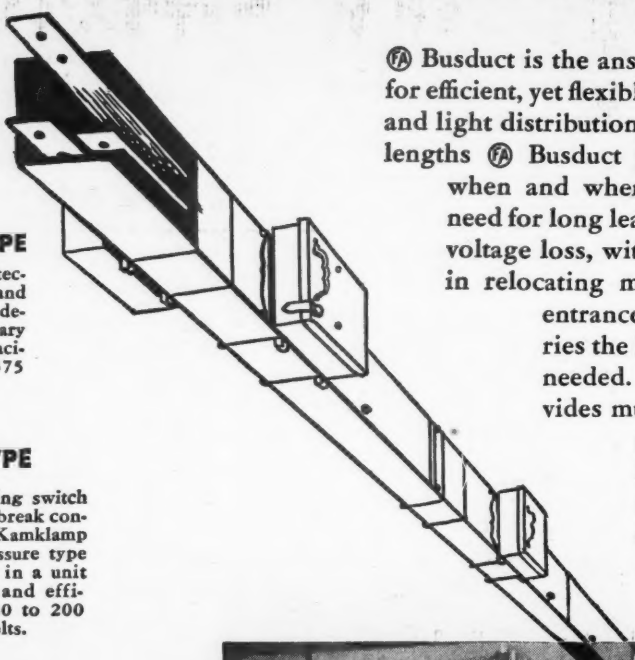


Made for capacities from 250 to 1000 amps. and for 575 volts AC or less with Plugin outlets for 30, 60, 100, and 200-amp. devices. Also Junior Plugin Busduct for 225 amp., 575 volts maximum.

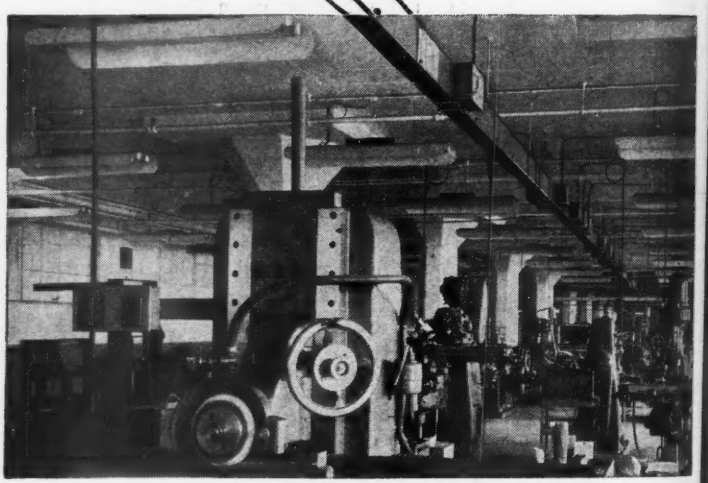
For heavy capacity connections between generators and main switchboards and for feeder distribution throughout the plant. Furnished in 2, 3 or 4 conductors; 250 amp. and up.

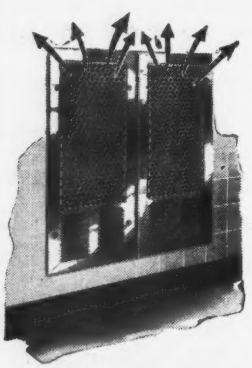


A complete and flexible duct system for light, heat and power distribution. In 1, 2, 5 and 10 ft. sections with elbows, closures, tees, pull boxes, and various couplings.



FA Busduct is the answer to the modern need for efficient, yet flexible and economical power and light distribution. Built in standard 10-ft. lengths FA Busduct provides all the power when and where needed. There is no need for long lead-ins, with a consequent voltage loss, with FA Busduct; no delays in relocating machinery. From service entrance FA Feeder Busduct carries the heavy current where it is needed. FA Plug-in Busduct provides multiple outlets for equipment closely grouped. Ideal for both large and small plants, and for light and heavy machinery.





FA Quikheters are available in single units of 1000 and 1500 watts and twin units of 2000 and 3000 watts.

FA ELECTRIC QUIKHETER

Here is an item that should appeal to every home-owner — the new and improved Built-in FA Quikheter.

Equipped with a genuine Nichrome element that should never wear out, these attractive, easy to install, comfort-giving units will send forth a glow of warm air in less time than it takes to build a fire — thus providing substantial savings in time and fuel.

Frank Adam Electric Co.

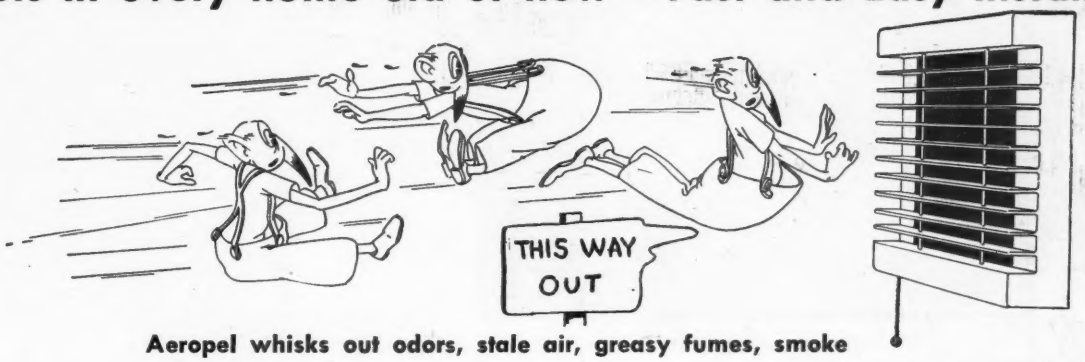
3654 Windsor Place St. Louis 13, Mo.

NEW Aeropel
Home Ventilator

Aeropel

Keeps kitchens fresh as a daisy!
also bedrooms, bathrooms, nurseries, recreation and utility rooms. Ample capacity for many offices, too!

Wins customers for builders — Profits for dealers
Markets in every home old or new — Fast and Easy Installation



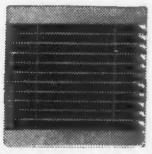
Aeropel whisks out odors, stale air, greasy fumes, smoke

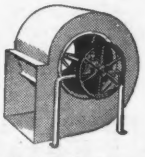
YOU CAN SELL AEROPEL! Priced *right* for competitive selling—compare its performance and appearance with other fans. Ask your jobber or supply house. If he cannot supply you, phone or write the nearest American Blower Branch Office.

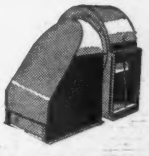
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION


Attic Fans


Aeropel Home Ventilators


Ventilating Equipment


Air Conditioning Blowers

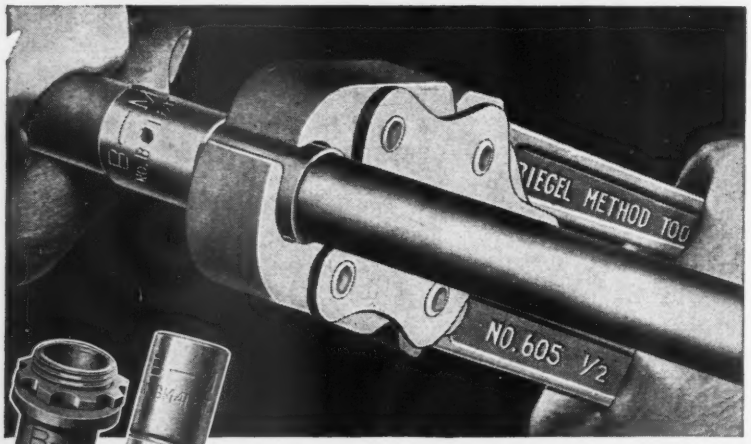
4 Years of War-Stimulated Improvement—On Top of 61 Years of Engineering Development

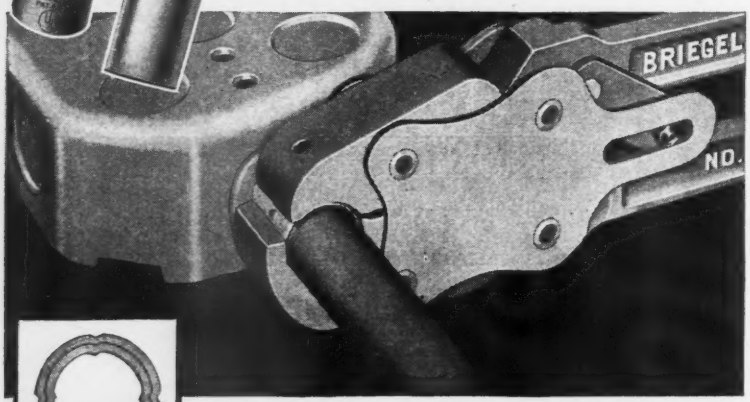
E·M·T

INSTALLED THE QUICK WAY WITH

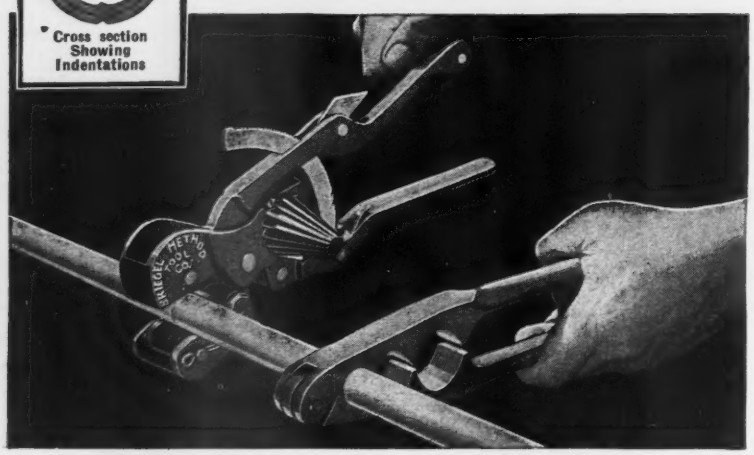
ORIGINAL "BRIEGEL" CONNECTORS · COUPLINGS AND TOOLS

For ½", ¾", and 1" ELECTRICAL METALLIC TUBING (Thin Wall Conduit)





* Cross section Showing Indentations



E·M·T

UP THE *Quick* WAY

WITH

Briegel Method Fittings

(All B-M Fittings carry the Underwriters Seal of Approval.)

TWO QUICK SQUEEZES give you finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then, too, they are stronger, neater, and much easier to work with in tight places. Start using B-M fittings today. Have more satisfied customers—more profits from each job!

Automatic Feed Tube Cutter

Cut ½", ¾" and 1" E. M. T. the quick, easy way! Only one Setting. Just clamp the Briegel No. 100 Tube Cutter on the E. M. T. and give it a few turns. No further adjustments necessary. Constant Spring Tension does the rest—gives you a clean cut from the original setting—does away with the tube distortion and gives longer cutter life. A Handy Reamer is attached to its side. A couple of twists removes any slight inside burr.

Also shown is the Briegel Tube Holder that accommodates all sizes of E. M. T. from ½" to 1" without damage to outer coatings.

BRIEGEL METHOD TOOL COMPANY

GALVA, ILLINOIS

WM. WURDACK ELECTRIC MANUFACTURING CO.

4444 Clayton Avenue **St. Louis 10, Mo.**

Representatives:

ARNOLD, FRED C.	410 Bond Bldg., 14th & New York Ave., NW., Washington 5. D. C.
CLARK EQUIP. & MFG. CO., JOHN S.	P.O. Box 3143, Sta. A., El Paso, Texas
DORN EQUIPMENT CO.	89 Broad St., Boston, Massachusetts
ENGINEERING SALES ASSOC., INC.	324 Stephenson Bldg., Detroit 2, Mich.
FLEMING, B. J.	337 Law Bldg., 1207 Grand Ave., Kansas City, Mo.
THE GEARY EQUIPMENT CO.	P.O. Box 467, Omaha, Nebraska
GETCHELL, F. H.	53 W. Jackson Blvd., Chicago 4, Ill.
HARRIS, H. R.	708—6th Avenue So., Minneapolis 15, Minn.
HIBBARD CO., ALEX	1863 Wazee, Rm. 408, Denver 2, Colo.
LEWIS, F. S.	Bourse Bldg., Machinery Exhibit Basement, Philadelphia 6, Pa.
NURO COMPANY	414 Houston Bldg., San Antonio 5, Texas
	301 Southland Life Bldg., Dallas 1, Texas
	1703 Olive St., Houston 13, Teras
REED, LYMAN C.	1001 St. Charles St., New Orleans 8, La.
REIGHART, J. L.	4617 Duncan St., Louisville, Ky.
S. W. SALES & SERVICE CO. CURTIS H. STOUT	1808 Beachwood Rd., Little Rock, Ark.

The Wurdack panelboards and switchboards shown and described on these pages are only a few of the many types, sizes and capacities manufactured by the Wm. Wurdack Electric Mfg. Company, designers and manufacturers of switchboard equipment exclusively for over fifty years. Wurdack equipment is in use in many parts of the world. Every requirement for electric power control and distribution can be met by standard design of equipment or by equipment especially designed in accordance with your most exacting requirements. All products are listed with the Underwriters' Laboratories, Inc.

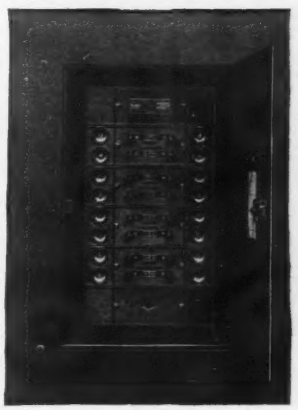
Switchboards, Live front or dead front

Distribution Panels, dead front fusible or circuit breaker type.

Lighting Panels, fusible or circuit breaker type.

Theatre Switchboards.

Experimental Laboratory Switchboards and Service Outlets



CIRCUIT BREAKER PANELS

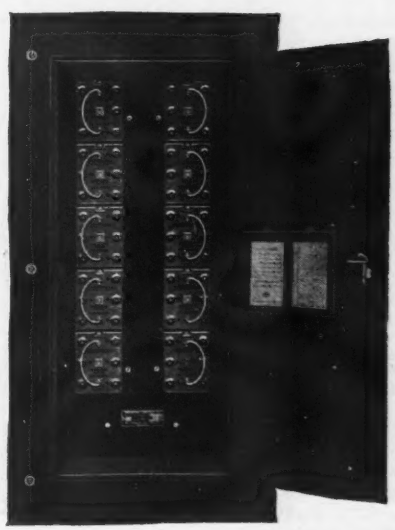
Made in three general types. No. 1 for Lighting and Appliance Branch Circuits. No. 2 Narrow Distribution Type. No. 3 Convertible Distribution Type. All panels are constructed with individually inclosed inverse time limit thermal overload Circuit Breakers. Design of all panels is such that individual breakers may readily be removed from panel.

DEAD FRONT LIGHTING AND APPLIANCE CIRCUIT PANELS

Complete line of dead front lighting panelboards, constructed of standardized sections of moulded plastic. All switches and fuse receptacles are readily removable from front of panel. All cabinets made of code gauge galvanized sheet metal. Fronts of full finished stretcher leveled steel rustproofed and having a grey lacquer finish. Fronts are provided with flush hinges, adjustable trim clamps and combination lock and catch.

DEAD FRONT DISTRIBUTION PANELS

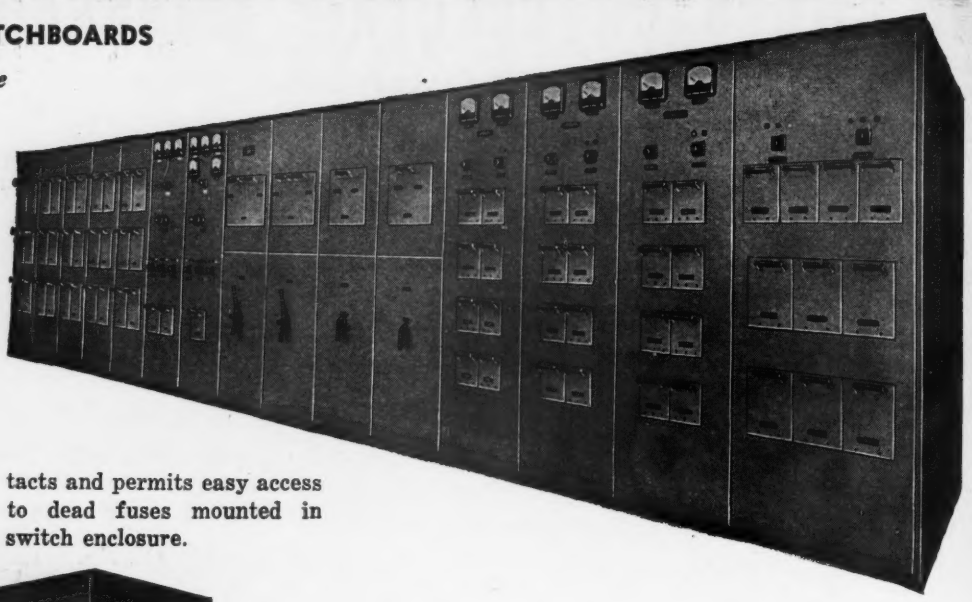
A complete line of dead front distribution panels for 250 V. and 600 V. service constructed of standardized switching units. All branch circuits from 30 to 100 amperes inclusive are equipped with moulded plastic pull switch units; branch circuits of larger capacity are equipped with Auto-shift units of the hinged type. All cabinets constructed of code gauge galvanized sheet steel. Fronts with full finished stretcher leveled steel, rustproofed and finished with grey lacquer.

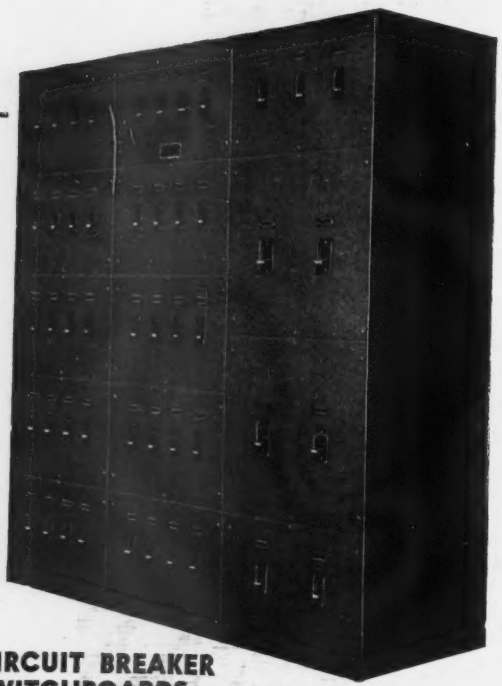


MAIN DISTRIBUTION SWITCHBOARDS

ER Safety Type

The latest in safety features are applied to the construction and operation of the fully enclosed type ER Safety Type WURDACK Distribution Switchboards. Switch units are Auto-shift type either single or double throw in capacity and voltage as required. Danger of any contact with live parts is entirely eliminated by use of these dead front switch units. Opening of door automatically breaks and shifts contacts and permits easy access to dead fuses mounted in switch enclosure.





CIRCUIT BREAKER SWITCHBOARDS

For light and power distribution. All circuit breakers are inverse time limit thermal overload type and where required have instantaneous magnetic trip on short circuit. A compact assembly permitting sufficient space for wire connections in rear space. These switchboards are designed so that additions may be made later if necessary.

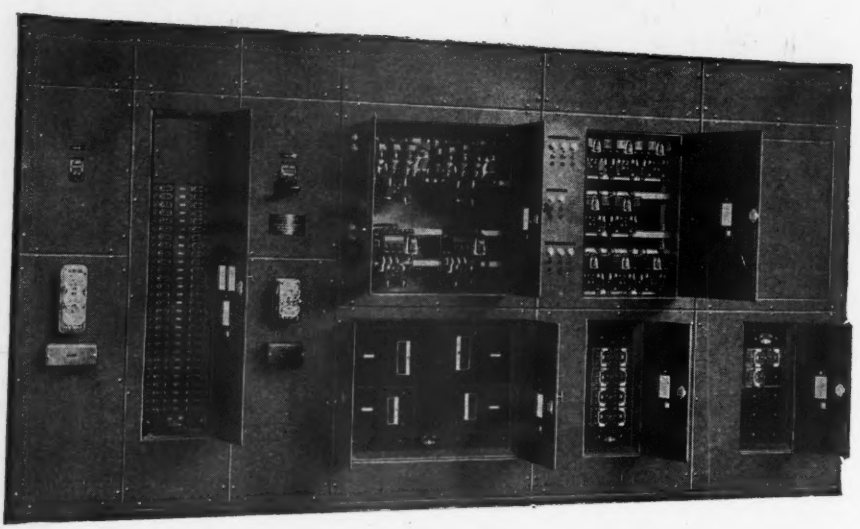
UNIT SUB-STATIONS

WURDACK Unit Sub-station switchboards designed for direct connection to transformers. These switchboards are furnished with either rigid or draw-out type circuit breakers and other equipment as may be required.

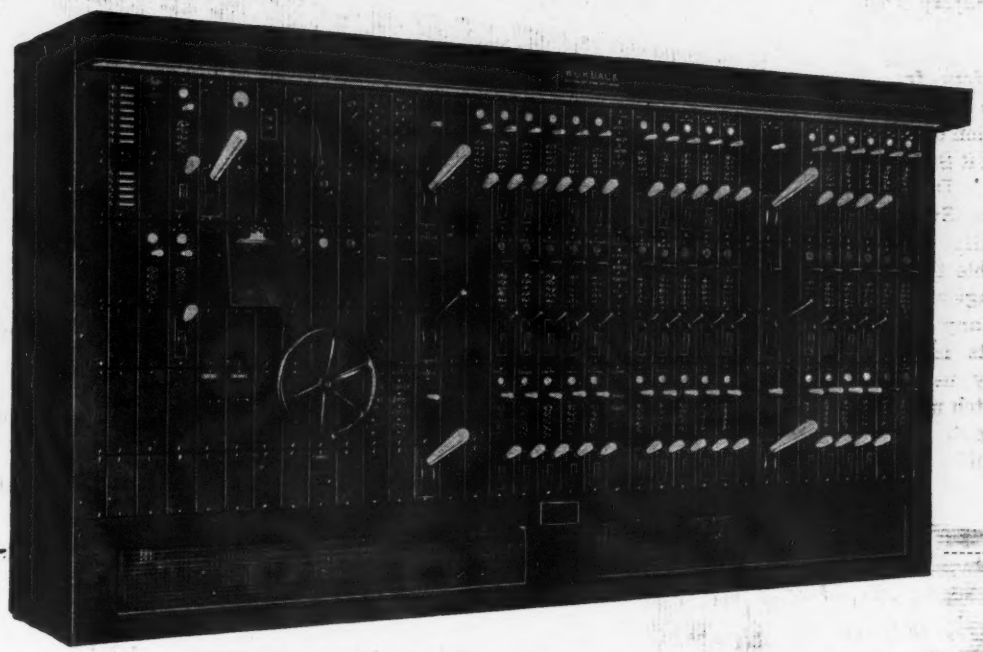
MOTOR CONTROL SWITCHBOARDS

Sewage Disposal Plant Installation

In combination with power and light distribution control circuits. Entire unit of sectionalized design permitting addition of future motor control or power and light circuits. Front connection permits easy access to all circuit wiring.



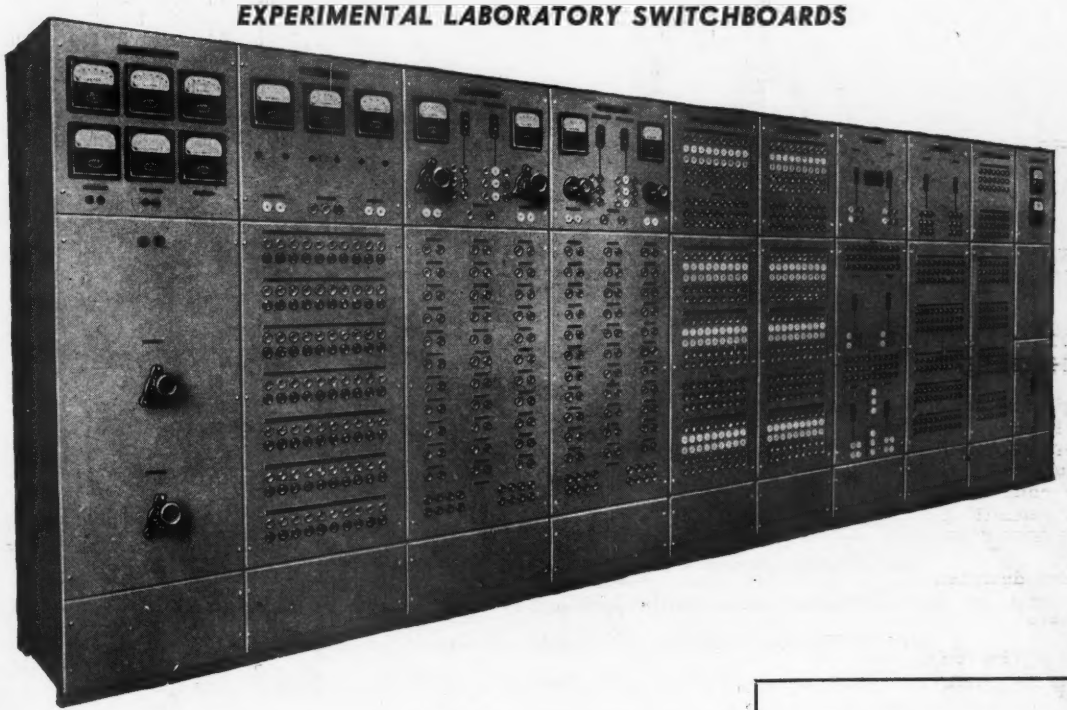
STAGE AND THEATRICAL LIGHTING CONTROL SYSTEMS



Multi-Master Pre-set Remote Control System

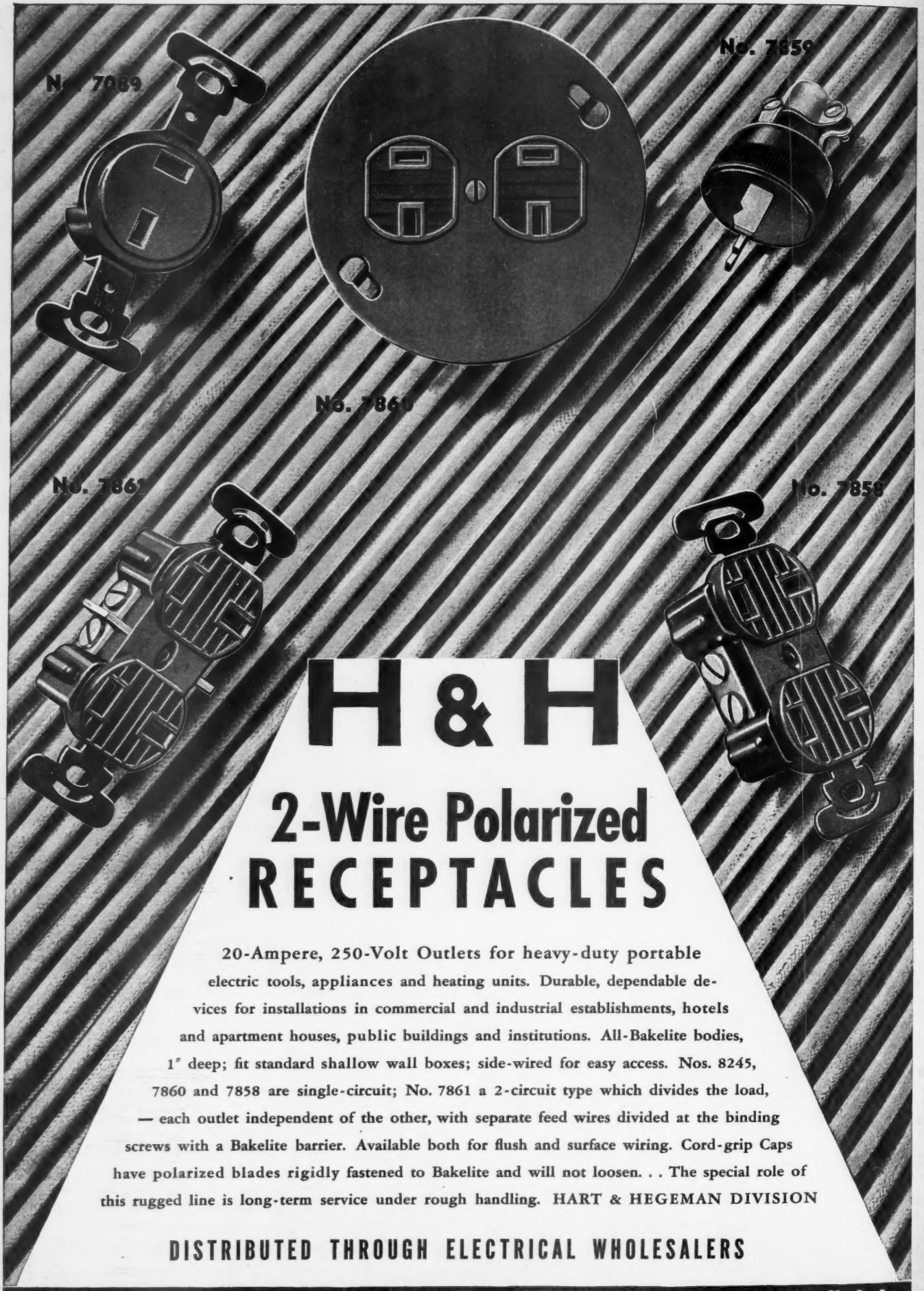
WURDACK Multi-Master Pre-Set Stage and Auditorium Lighting Control System. With the combination switchboard and dimmer bank illustrated above, it is possible to set up, in advance, five entirely different sets of lighting effects after which time any one light plot can be selected by simply operating a single master switch.

EXPERIMENTAL LABORATORY SWITCHBOARDS



All plugs and jacks, and many of the other special parts required for the construction of these parts, are of our own design and manufacture, making it possible to maintain a continuous high standard of quality and performance. In addition to the switchboards and panels we also provide the many special outlets or service panels required in connection with a complete laboratory electrical system.

WURDACK Experimental Laboratory Switchboards and Panels can be furnished for any size or kind of science or industrial testing Laboratory where electrical energy, in various forms and voltages, is required for experimental or research work.



H & H

2-Wire Polarized RECEPTACLES

20-Ampere, 250-Volt Outlets for heavy-duty portable electric tools, appliances and heating units. Durable, dependable devices for installations in commercial and industrial establishments, hotels and apartment houses, public buildings and institutions. All-Bakelite bodies, 1" deep; fit standard shallow wall boxes; side-wired for easy access. Nos. 8245, 7860 and 7858 are single-circuit; No. 7861 a 2-circuit type which divides the load, — each outlet independent of the other, with separate feed wires divided at the binding screws with a Bakelite barrier. Available both for flush and surface wiring. Cord-grip Caps have polarized blades rigidly fastened to Bakelite and will not loosen. . . The special role of this rugged line is long-term service under rough handling. HART & HEGEMAN DIVISION

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

HAZARD

ELECTRICAL WIRES AND CABLES

N.E.C. Approved for the Construction Industry

SELECTION CHART

. . . a simple, time-saving key to insulated wires and cables for every electrical use.

	APPLICATION	RECOMMENDED CABLE	MAX. VOLTAGE	REMARKS
BUILDINGS	Distribution—Feeders and Power Cables	Performite	600	Type RH for general use and high temperatures
		Watertite	5000	Type RW for wet locations
	Branch Feeders, Interior Power and Light Wiring	Performite	5000	Type RH for general use and high temperatures
		Hazakrome	600	Types T & TW for general use and wet locations
		Hazacode	5000	Type R, general use
	Armored Cables	Hazard Armored	600	Loxsteel metallic armor
		Hazardex	600	Non-metallic sheathed with Type R insulation
		Hazardex-T	600	Non-metallic sheathed with Type T insulation
SERVICE	Drop Cable	Hazard Drop	600	Type SD concentric
	Entrance — Outside	Hazard Entrance	600	Types ABN and UBN
	Entrance — Underground	Hazard Entrance	600	Types USE, ASE and Armortite
UNDERGROUND	In Ducts	Lead Covered	5000	Various insulations available as in building wires above
	Buried Direct	Armortite	7500	Non-metallic armored
		Parkway	7500	Lead sheath metallic armor
		Hazasheath	7500	Synthetic rubber type, non-metallic
		Hazakrome Thermoplastic	5000	Non-metallic thermoplastic insulation and jacket
PORTABLE	Portable Power Leads	Hazacord	600	Types S and SO
			300	With tough rubber or oil-resisting Hazaprene jacket Type SJO

HAZARD FIREKROME BUILDING WIRES

Firekrome is a special finish that offers you the highest Hazard development in braid coverings for building wires. Its flame resistance and moisture resistance mean extra years of service with added safety from those wiring circuits where Hazard Firekrome is used. It's clean to handle . . . doesn't soften or harden with temperature changes . . . pulls easily into conduits without bunching or slipping.

All Hazard building wires can be made with lead sheaths for wet locations.

HAZARD FIREKROME BUILDING WIRES

Available with Four Grades of Rubber Insulation

1 HAZACODE—TYPE R — Performance Grade Rubber Insulation meeting the requirements of the 1946 National Electrical Code.

Advantages: The Performance Grade Rubber Insulation now required by the N.E.C. contains a higher percentage of rubber than the old Code Grade, is therefore more resilient and elastic; has higher electrical characteristics, and also has greater carrying capacity because the temperature limit has been raised from 50° to 60° C.

Voltage and Operating Temperature Limits: 5,000 volts, 60° C.

Protective Coverings: As required, pages 2 and 3.

Recommended for: General interior building wiring.

Range of Design: In all sizes, and required number of conductors. Large color range.

2 PERFORMITE—TYPE RH — A super-aging, heat-resistant rubber insulation.

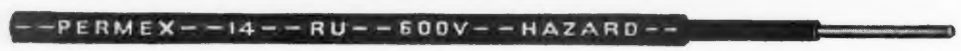
Advantages: Heat-resistant — greater current carrying capacity — meets ASTM accelerated aging tests with large margin of safety — free stripping — easy to install.

Voltage and Operating Temperature Limits: 8,000 volts, 75° C.

Protective Coverings: All types depending on conditions — see pages 2 and 3.

Recommended for: Municipal, fire and police alarm — in buildings for branch feeders and general light and interior wiring, hot locations.

Range of Sizes: All sizes and required number of conductors. Meets requirements of ASTM Specifications.



3 WATERTITE—TYPE RW — Type RW rubber insulation especially designed to meet mechanical and specific inductive capacity requirements for moisture-resistance.

Advantages: N.E.C. approved for use without lead in damp location — light weight and greater convenience in handling — free stripping — long aging — tough and elastic — high dielectric strength.

Voltage and Operating Temperature Limits: 5,000 volts, 60° C.

Protective Coverings: All kinds, depending on conditions. See pages 2 and 3.

Recommended for: Wet locations where lead is undesirable, either indoors or outdoors — bore-hole and shaft cables — power cables in coal and metal mines — submarine cables.

Range of Design: All sizes and number of conductors — large color range, **Bulletin 168A.**

4 PERMEX (Latex) — TYPE RU — Low voltage rubber Latex insulated, small diameter building wire.

Advantages: Exceptional mechanical strength and elasticity — high dielectric strength and insulation resistance—weatherproof, flame-resistant — smooth lubricated finish. Full approval under 1946 National Electrical Code.

Voltage and Operating Temperature Limits: 600 volts, 60° C.

Protective Covering: Dilec fibrous sheath.

Recommended for: General light and power wiring—low voltage circuits — crowded conduit and small space — new and rewiring.

Range of Design: Size Nos. 14 to 6. Standard building wire colors.

HAZAKROME THERMOPLASTIC WIRES

HAZAKROME—TYPES T AND TW — Low voltage Types T and TW small diameter thermoplastic building wire for new wiring maintenance and for rewiring and increasing capacity of existing conduit in both dry and wet locations.

Advantages: No braids required — resists moisture, heat, oils, sunlight, chemicals and flame.

Voltage and Operating Temperature Limits: 600 volts, 60° C.

Protective Covering: No covering required.

Recommended for: New and rewiring — general light and power in building—low voltage circuits—thin-wall—to get more power through existing raceways.

Range of Design: The only type small diameter wire available in all sizes — wide color range. **Bulletin H-406.**

HAZARD ARMORED BUILDING WIRES

HAZARD METALLIC ARMORED CABLE — for interior wiring.

Advantages: Light and easy to handle; sturdy, simple construction, no conduit required; may be insulated with superaging Performite.

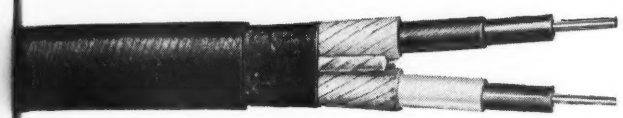
Voltage and Operating Temperature Limits: 600 volts, 60° C. if insulated with Hazacode Performance Insulation, 75° C. if insulated with Performite.

Protective Coverings: Interlocked galvanized steel tape armor.

Recommended for: All purposes where Armored Cable may be used.

Range of Sizes: Sizes 18 to 1, single and multi-conductor.

Bulletin 189.



HAZARDEX NON-METALLIC SHEATHED CABLE — for interior wiring.

Advantages: Light, easy to handle and install, offers economy and simplicity, has high insulation value, employs standard fixtures and accessories; may be insulated with super-aging Performite. May be insulated with Hazacode Performance compound or Super-Aging Performite, or Thermoplastic.

Voltage and Operating Temperature Limits: 600 volts; 60° C. if insulated with Hazacode Performance; 75° C. if insulated with Performite; 60° C. if insulated with Thermoplastic.

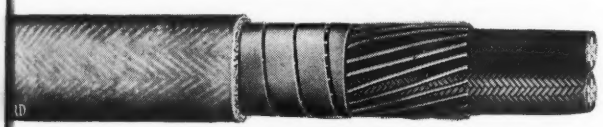
Protective Coverings: Paper cushion on each conductor with paper wrap and heavy cotton braid over all; hard, clean, flame-resisting weatherproof finish.

Recommended for: House wiring, both new and extensions to existing systems, rural buildings, garages, shops and small stores, circuits for refrigerators, radios, etc., electric range power circuits.

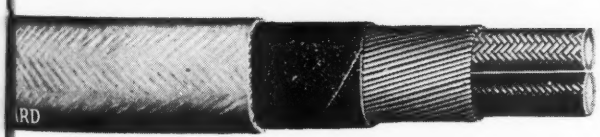
Range of Sizes: Sizes 14 to 4, two and three conductors.

Bulletin H-402.

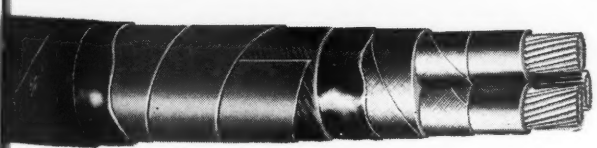
HAZARD SERVICE ENTRANCE AND DROP CABLES



STYLE ABN (Type SE) — Armored Bare Neutral. For low cost service entrances this Hazard Cable is ideal because it requires no conduit . . . may be strapped to the house which means a fast, easy installation job. Galvanized steel armor tape between the concentric neutral conductor and the outer coverings provides plenty of protection against injury and current diversion.

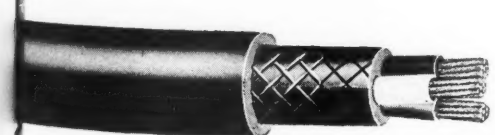


STYLE UBN (Type SE) — Unarmored Bare Neutral. Light in weight and low in cost, this cable will carry a circuit in an unbroken line from pole to meter or entrance switch without using conduit. Instead of steel armor, a heavy double tape cushion provides protection against injury and moisture. A large number of wires in the concentric bare neutral make the cable diversion proof. Because of its light weight and low cost Style UBN can be used as both a Drop and Service Cable.



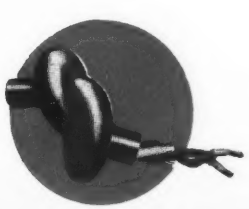
TYPE USE — Armortite Underground Service Cable. For underground services to buildings and between buildings. It's a low cost non-metallic protected cable that's unaffected by moisture, acids, etc. when buried directly in the ground without conduit. Having neither lead sheath nor steel armor, Hazard Armorite is light in weight and easy to install.

HAZARD PORTABLE CORDS AND CABLES



HAZACORD — Three features make Hazacord portable cords and cables deliver outstanding values.

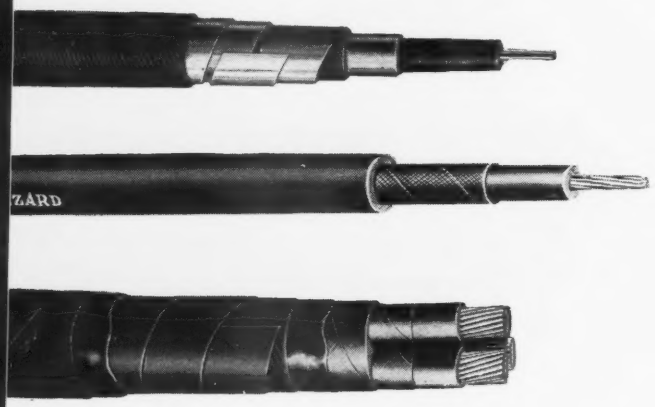
Advantages: *Extra flexibility* because of the large number of fine copper wires that are stranded to form the conductors . . . *High tensile strength* of the strong rubber insulation that prevents "shorting" when cable receives hard treatment . . . *Tough rubber jacket* that's resilient and tear-proof because it's vulcanized under extreme pressure in continuous metal molds. Also available with Hazaprene sheath (made with neoprene).



Recommended for: every situation where portable cords or cables can be used. Types of Hazacord products fill needs which range from servicing small portable lamps to supplying power to giant dredges and shovels.

Range of Design: Available in all sizes to meet every need and with Size 8 AWG and larger. A Hazaprene Jacket, made with neoprene, is supplied at no extra cost, which, in addition to being unusually tough, is also resistant to oil, chemicals, acids, water, sunlight.

HAZARD UNDERGROUND AND BURIED CABLES



PARKWAY— Lead-sheathed for moisture protection, armored with 2 flat steel tapes so wound that the outer covers the spaces between turns of the inner. Also made with single "S" shaped interlocked steel tape armor (Hazard Loxsteel Cable). **Bulletin 146.**

HAZASHEATH— An all-rubber protected non-metallic underground cable. Hazaprene oil-resisting jacket can be supplied where desired. **Bulletin 377.**

ARMORTITE— Non-metallic underground cable with protective coverings of asphalted jute, leather-like armor tape, plastic sealing compound and rubber faced tapes. Lighter and less costly than Parkway Cable. Not affected by moisture, acids or alkalies.

Advantages: Can be buried direct in ground—high mechanical strength—no conduit required—easy to install.

Voltage Limits: 7,500 volts.

Recommended for: Street and airport lighting—underground circuits — mine feeders.

Range of Sizes: All sizes and with required number of conductors. **Bulletin 115-A.**

HAZAKROME THERMOPLASTIC — Non-Metallic Underground Cable with insulation and protective jacket of thermoplastic material with tape and braid covering, suitable for street and airport lighting and underground circuits.

Voltage Limits: 600 volts for power cable, 5,000 volts for series lighting circuits.

Range of Sizes: All sizes, and with required number of conductors.

TAPES AND SPLICING MATERIALS

MANSON FRICTION TAPE— Unequaled in true adhesiveness and in aging and weathering qualities. Provides lasting protection for joints. Rolls, ¾" wide containing 78 ft. (in ½ lb. cans).*

OKONITE RUBBER TAPE— Fuses into a homogeneous wall of tough insulation. Permanently waterproof, elastic and resilient. Highest dielectric strength. Rolls, ¾" wide containing 30 ft. (in ½ lb. cans).*

OKOLITE HIGH-VOLTAGE CORONA-RESISTING TAPE — For splicing ozone-resistant, rubber-insulated cables, particularly those operating at over 2,000 volts between phases. Provides superior ozone resistance, high dielectric strength, moisture resistance, low specific inductive capacity and low power factor. Unaffected by low temperatures. Rolls, ¾" wide containing 30 ft. (in ½ lb. cans).*

OKOPRENE SPLICING TAPE — made with neoprene, it possesses higher resistance to ozone, oil and weather. Has excellent aging, moisture-resisting, physical and electrical properties. Rolls — ¾" containing 30 ft. (½ lb. roll).*

Okoprene Splicing Tape is designed to replace friction tape containing fibrous material and is especially recommended for protecting joints and terminals on neoprene-covered cables.

OKONITE CEMENT — Pure rubber dissolved in a suitable solvent. Applied to the copper and the original insulation, Okonite Cement insures proper adherence of the splicing compound. In 2, 4, 8, or 16-oz. containers.

*Other widths and weights only when requested.

HAZARD INSULATED WIRE WORKS

DIVISION OF THE OKONITE COMPANY
Wilkes-Barre, Pa.
Branch Offices

Atlanta 3, Ga.....1606 Rhodes-Haverty Bldg.
Birmingham 3, Ala.....1520 Comer Bldg.
Boston 16, Mass.....1100 Statler Bldg.
Chicago 6, Ill.....20 North Wacker Drive
Cleveland 14, Ohio.....625 Engineer's Bldg.
Dallas 1, Texas.....P. O. Box 694
Detroit 26, Mich.....1709 Ford Bldg.
Indianapolis 4, Ind..417 Merchants Bank Bldg.
Los Angeles 21, Calif.....2441 Hunter Street
New Orleans 12, La...904 Pere Marquette Bldg.
New York 17, N. Y.....501 Fifth Avenue
Philadelphia 3, Pa.....Broad St. Station Bldg.
Pittsburgh 19, Pa.....1317 Gulf Bldg.
Portland 3, Oregon...907 Terminal Sales Bldg.
San Francisco 4, Calif.....1664 Russ Bldg.
Seattle 1, Wash.....1501 Northern Life Tower
St. Louis 3, Mo.....1410 Shell Bldg.
Washington 4, D. C.....550 Munsey Bldg.
Wilkes-Barre, Pa.....72 Hazle Street

H-283

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WHEN YOU SELL LIGHTING

Fluorescent ballasts, in quick start and standard types, all popular sizes from 15 to 100 watt, single 2, 3 and 4 lamp.

Slim Design ballasts, in power factor and normal types.

Cold Cathode ballasts for 22 and 25mm, 93" long lamps.

Industrial and Commercial type Cold Cathode Transformers for series installations.

feature the BETTER PERFORMANCE *of* ACME BALLASTS *and* TRANSFORMERS

Why do uniformly processed lamps with uniformly-high test records differ greatly in light output and service life? Look to the ballast as the important source of performance! Acme Electric ballasts and transformers are designed and built to provide maximum overall performance, to maintain operating characteristics within the limitations satisfactory to the lamp —whether it be standard fluorescent, slim design or cold cathode.

Annealed steel cores, vacuum impregnated coils, heat dissipating compound provide for balanced secondary voltage output, maximum light output, noise free, long life service. These are the results your customers want.

Acme Electric manufactures Luminous Tube Transformers—Fluorescent Lamp Ballasts — Cold Cathode Lighting Transformers and Ballasts — Mercury Vapor Lighting Transformers — Radio and Television Transformers — Electronic Transformers — Door Bell, Chime and Signalling Transformers — Safety Transformers — Voltage Regulating Transformers—Step Down Transformers—Control Transformers — Warp-stop Transformers — Capacitor Transformers for Power Factor Correction—Air Cooled Power Transformers—Rectifiers.

IN CANADA, Acme Electric & Manufacturing Co. of Canada Ltd.
1434 St. Catherine St., W., Montreal 25, Que.

ACME ELECTRIC CORPORATION
36 WATER STREET • • • CUBA, N. Y.

Acme ACME Electric
TRANSFORMERS

ALL-BRIGHT ELECTRIC PRODUCTS COMPANY

3917-25 N. KEDZIE AVE. • CHICAGO 18, ILLINOIS

Custom Built ALL-BRIGHT Fluorescent Fixtures . . . the ULTRA in Fluorescent Lighting . . . designed for better efficiency . . . better lighting . . . easy maintenance. Can be mounted individually or in continuous rows—flush or suspended.

ALL-BRIGHT FLUORESCENT LIGHTING FIXTURES

RESEARCH TYPE SKYLIGHT UNIT

Glass Enclosed

The SKYLIGHT custom built luminaires produce an unusually soft, shadowless illumination, recommended for better vision. Can be used individually or in well spaced continuous parallel rows, and either suspension or flush mounting. Equipped with glass panels or artistic metal louvres.

Style	Description	Lamps	Watts	List Price
RU-204-F	Flush mounting, 25" long	4	20	$30.00
RU-204-S	Suspension, 24" double stems, 25" long	4	20	33.00
RU-402-F	Flush mounting	2	40	35.00
RU-402-S	Suspension, 36" double stems	2	40	38.00
RU-404-F	Flush mounting	4	40	47.00
RU-404-S	Suspension, 36" double stems	4	40	50.00
RU-1002-F	Flush mounting	2	100	55.00
Louvre	RU-402 or RU-204	..	....	6.00
Louvre	RU-404 or RU-208	..	....	8.00
Louvre	RU-1002	..	....	12.00

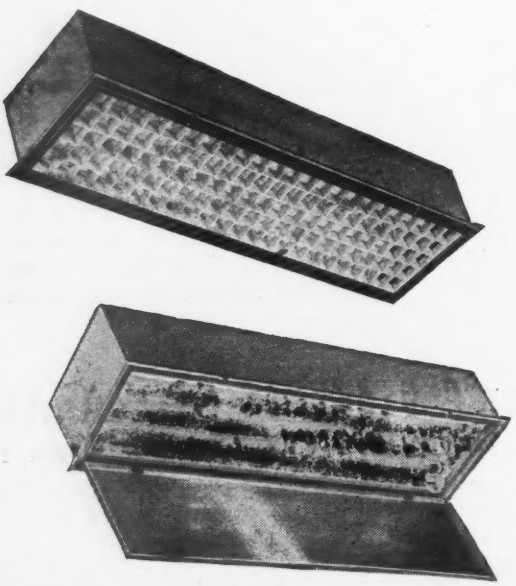
For instant start add $5.00 to list price for RU-402; add $10.00 to list price for RU-404.

COMMERCIAL UNITS—LARGE TYPE

118 Volts A.C.

The ALL-PURPOSE Commercial luminaires are of the conventional type, except, that they are especially designed for inexpensive conversion into Skylight RU types, listed above. Easily accessible for wiring and maintenance, as illustrated.

Style	Description	Lamps	Watts	List Price
HF-402-F	Flush mounting	2	40	$22.00
HF-402-S	Suspension, 36" double stems	2	40	25.00
HF-403-F	Flush mounting	3	40	29.00
HF-403-S	Suspension, 36" double stems	3	40	32.00
HF-404-F	Flush mounting	4	40	36.00
HF-404-S	Suspension, 36" double stems	4	40	39.00
HF-1002	Flush Mounting	2	100	45.00
HF-204-F	Flush mounting, 49" long—DC	4	20	32.00
HF-204-S	Suspension, 49" long—DC	4	20	35.00
HF-208-F	Flush mounting, 49" long—DC	8	20	59.00
HF-208-S	Suspension, 49" long—DC	8	20	62.00



RECESSED UNITS—118 Volts A.C.

The popular ALL-BRIGHT Recessed Luminaires feature an attractive frame with a self-aligning, level mounting clip, that adjusts itself to the most uneven ceiling. Piano hinged, and quick slide catches are used to make all component parts accessible with ease. Glass panels or full depth metal louver of either egg-crate or honeycomb types. These units readily lend themselves to room atmosphere, are inconspicuous and provide high level, eye comfort illumination. Can be mounted individually or in continuous well spaced, parallel rows.

Style	Description	Lamps	Watts	List Price
*REC-220	24" long, Hinge Frame	2	20	$30.00
*REC-320	24" long, Hinge Frame	3	20	33.00
*REC-420	24" long, Hinge Frame	4	20	36.00
REC-240	48" long, Hinged frame only	2	40	50.00
REC-440	48" long, Hinged frame only	4	40	65.00
Louvre	REC-240 or REC-440	..	....	6.00
REC-2100	60" long	2	100	55.00
Louvre	REC-2100	..	....	10.00

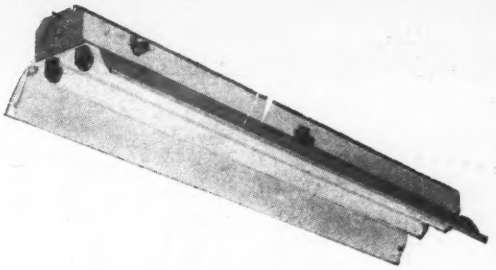
*Can be furnished with screw cover frame.

ALL-BRIGHT FLUORESCENT LIGHTING FIXTURES

INDUSTRIAL UNITS—118 Volts A.C.

ALL-BRIGHT INDUSTRIAL Units are of interest to every purchaser, because they have: Removable Heavy Gauge Steel Reflector; Louvered Housing; Accurate Lamp Adjustment; Remote Starter Control; Removable Lamp Holder Plates.

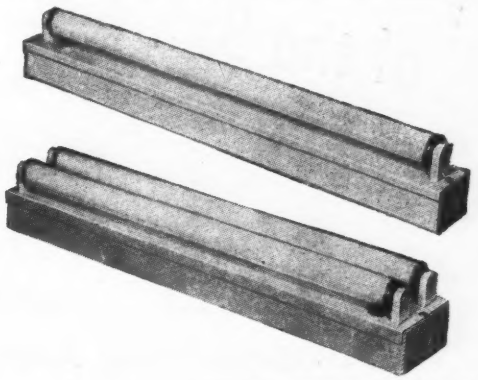
Finish is durable baked white enamel. Designed for chain, stem, or surface mounting.



Style	Description	Lamps	Watts	List Price
CR-201	25" long	1	20	$ 8.00
CR-202	24" long	2	20	13.00
CR-301	37" long	1	30	14.50
CR-401	49" long	1	40	15.00
CR-402	49" long	2	40	20.00
CR-403	49" long	3	40	28.00
CR-1002	61" long	2	100	40.00
CR-402-IS	Instant start ballast	2	40	26.00

CHANNEL STRIPS—118 Volts A.C.

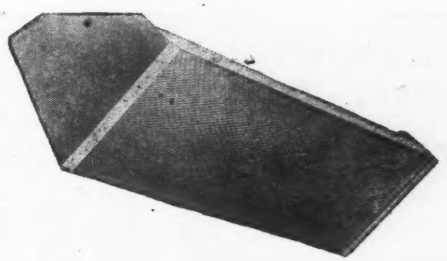
ALL-BRIGHT Channel Strips, either single, tandem, or parallel. Their applications are innumerable in any horizontal or vertical easy-to-install spots. Finished in enduring white and ideal for either modern or remodeling use.



Style	Description	Lamps	Watts	List Price
C-141	16" long	1	14	$ 5.50
C-151	18" long	1	15	5.50
C-201	25" long	1	20	5.50
C-202—Parallel	25" long	2	20	9.00
C-301	37" long	1	30	11.00
C-401	49" long	1	40	11.50
C-402—Parallel	49" long	2	40	18.00
C-402—Tandem	97" long	2	40	23.00
C-1001	61" long	1	100	27.00

"V" SHAPED UNITS—Glass Enclosed

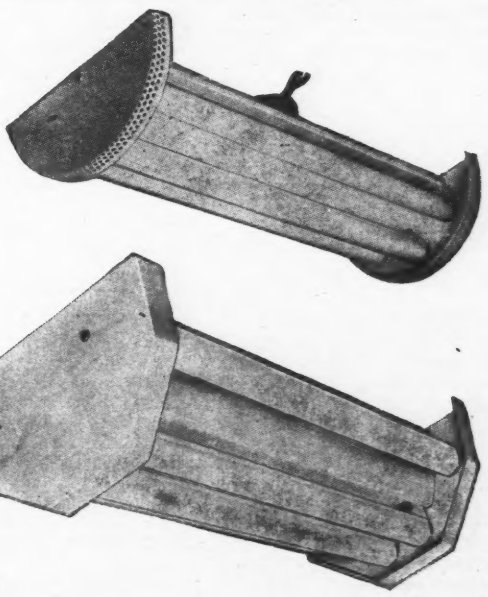
ALL-BRIGHT Utility Fixtures are intended primarily for fitting mirrors, corridors, alcoves, dinettes, and any other places where harmonious blending of fixture design with interior decorations is a paramount consideration. Though this model is modern and artistic it has all of the other well known ALL-BRIGHT features of sturdiness, easy accessibility and low up-keep.



Style	Description	Lamps	Watts	List Price
V-152-C	19" long, 6" canopy and strap	2	15	$16.00
V-153-C	19" long, 6" canopy and strap	3	15	19.00
V-202-C	25" long, 6" canopy and strap	2	20	16.00
V-203-C	25" long, 6" canopy and strap	3	20	19.00

KITCHEN AND COMMERCIAL UNITS

The Kitchen unit adapter type is interchangeable by merely replacing the present glass globe. The wide combination of possible methods of other KT types should be carefully considered. Heavy gauge construction, furnished in durable white enamel baked finish, with Hammerloid canopy and stem assemblies.



Small Type, 118 Volts, AC, LPF

Style	Description	Lamps	Watts	List Price
KT-202-F	Kitchen, Flush mounting	2	20	$ 9.25
KE-202-4	Kitchen, 4" adapter	2	20	9.25
KT-202-6	Kitchen, 6" adapter	2	20	9.75
KT-202-C	Kitchen, Ceiling canopy and strap	2	20	10.00
KT-202-S	Kitchen, Suspension, 24" stem and canopy	2	20	11.50
KT-203-F	Kitchen, Flush mounting	3	20	13.00
KT-203-4	Kitchen, 4" adapter	3	20	13.00
KT-203-6	Kitchen, 6" adapter	3	20	13.50
KT-203-C	Kitchen, Ceiling canopy and strap	3	20	13.75
KT-203-S	Kitchen, Suspension, 24" stem and canopy	3	20	15.00
KT-204-F	Commercial, Flush mounting	4	20	19.00
KT-204-4	Commercial, 4" adapter	4	20	19.00
KT-204-6	Commercial, 6" adapter	4	20	19.50
KT-204-C	Commercial, Ceiling mounting, canopy	4	20	19.75
KT-204-S1	Commercial, Suspension, single stem, canopy	4	20	21.00
KT-204-S2	Commercial, Suspension, double stem, canopy	4	20	22.00

ALL-BRIGHT Fixtures are Fire Underwriters and Electrical Testing Laboratories approved. I. B. E. W. fabricated. We are equipped to build fixtures to your architect's design and specifications. Write for descriptive circular on the completed line. LIGHT RIGHT WITH ALL-BRIGHT.

ALL-BRIGHT ELECTRIC PRODUCTS COMPANY

3917-25 N. KEDZIE AVE. • CHICAGO 18, ILLINOIS

Here's the Benjamin Lighting Equipment Selection Chart which illustrates the . . .

COMPLETENESS
of the Benjamin Lighting Equipment Line

. . . a completeness that is necessary to meet the many lighting requirements of

INDUSTRIAL PLANTS . . . STORES and OFFICES . . .
SCHOOLS . . . AUTO SERVICE STATIONS . . .
SPORTS and PLAY AREAS . . . FARMS

BENJAMIN LIGHTING EQUIPMENT SELECTION CHART

The "SHIELD-FLO 40"

Two-lamp Closed End Unit with longitudinal shield.

The "STREAM-FLO 40"

Closed End Units for two or three lamps.

The TWIN and TRIPLE-FLO UNITS

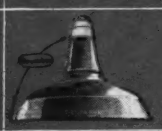
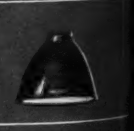
Open End Units for two and three lamps.

The New "LITE-LINE 40"

Two and three lamp continuous sliding channel units with either open end or closed end reflectors.

These new Benjamin Fluorescents feature the new exclusive
SPRING-LOX SAFETY LAMP HOLDER

An advancement in Socket durability and ease of re-lamping.

The coming new Benjamin Fluorescents	"Turnlox" Unique, bayonet, quick detachable construction by which lamp and reflector come down as a unit for easy cleaning on floor	"Socket-Reflector" Weatherproof one-piece equipment for use wherever removal of fixtures for easy cleaning is not a consideration.	"Type RR" Two-piece, threaded hood design of unusual sturdiness for use where fixtures are subjected to severe service conditions.	"1800 Series" Removable reflector construction; cast hoods hold reflectors by means of clamping ring controlled by two screws on hood.	Shade Holder Reflector sucks to 2-inch standard shade holders. "Snap-on" reflector holders available for attaching a variety of shades.
Dome The accepted standard for general lighting, provides illumination on both horizontal and vertical surfaces with minimum shadows.					
Shallow Dome Applicable to storage spaces indoors and yards outdoors where glare from partially shielded lamp is not objectionable.					
Flat Cone Usually used in locations where glare from entirely unshielded lamp is not objectionable and wide distribution required.					
Bowl Not suitable for present lighted installations, has some local lighting applications where low cut-off is desirable.					
Symmetrical Angle Not ordinarily suited for general lighting installations, has local applications in lighting from the side.					
Elliptical Angle For general lighting from the side. Provides wide, even distribution of light with favorable illumination on vertical surfaces.					
Glassteel Diffuser Provides very best general illumination; highest diffusion, practically no glare, soft, luminous shadows.					

Completeness is Essential to Meet ALL the Requirements of a truly Modern Lighting System

THIS IS Benjamin's 45th Anniversary year in the field of Industrial and Commercial Lighting.

It is no coincidence that through these years, Benjamin has stood for COMPLETENESS of line and BUILT-LIKE-A-BATTLESHIP construction.

These, experience has proven, are essentials to RIGHT LIGHT...light that meets the specific requirements of the seeing task and the special conditions of the location with sustained year-in-and-out efficiency.

In these days of supply shortages in all industry, it may seem strange to emphasize completeness when not all Benjamin Equipment is available for immediate delivery.

However, due to the completeness of the Benjamin line, even under today's temporary shortages, it is usually possible to select and specify some efficient Benjamin Lighting Unit which will provide the Right Light for the seeing task and the needs of the location. For fuller details, consult your Benjamin Catalog or the Benjamin Data pages contained in the Electrical Buyers Reference. BENJAMIN ELECTRIC MFG. CO., Dept. H, Des Plaines, Illinois.

These are the Requirements of RIGHT LIGHT in a modern lighting program

1 **Maintenance** — Lighting equipment must be designed to facilitate a regular and frequent cleaning schedule and be durably constructed to insure against deterioration of light output efficiency and operation interruption; must include special provisions for minimizing dust, dampness, breakage where excessive exposures exist.

2 **Adequate General Illumination** — Lighting units must provide effectively a sufficiently high level of illumination of proper quality and freedom from glare to meet needs of seeing tasks.

3 **Supplementary Lighting** — where certain operations require extremely high intensities, local lighting units are frequently desirable.

4 **Special Equipment for Hazardous Locations** — Special lighting units, to meet provisions of National Electrical Code, must be used in certain specified hazardous locations.

5 **Lighting Outdoor Areas and Yards** — Special units for yards, docks, play areas, sports fields, service areas, etc.

6 **Floodlighting and Sign Lighting** — Special units, closed and open types, for effective floodlighting of "building-and-grounds," and sign lighting.

YOU LIGHT RIGHT WHEN YOU LIGHT WITH

BENJAMIN

Lighting Equipment

Distributed Exclusively Through Electrical Wholesalers

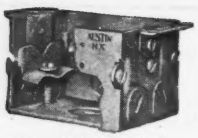
THE M. B. AUSTIN COMPANY

Established 1894

108-110 So. Desplaines Street

Chicago 6, Illinois

Type LR Beveled Cornered Switch Box



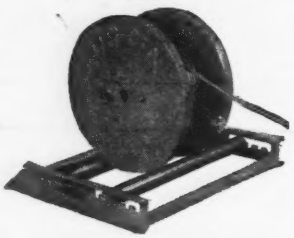
Type NX Patented Switch Box

Type BXFA Switch Box with Side Mounting Bracket

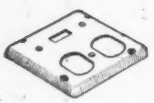
No. 9-0-½ 4" Octagon Outlet Box

No. 7910 4" Round Plaster Cover with Ears

No. 9-NX 4" Octagon Box with Internal Clamps

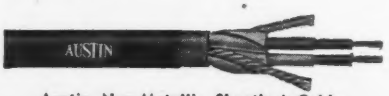


REEL ROLLER



No. 7385 4" Square Cover for Toggle Switch and Duplex Receptacle

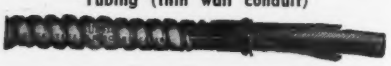
YARD LIGHTS



Austin Non-Metallic Sheathed Cable

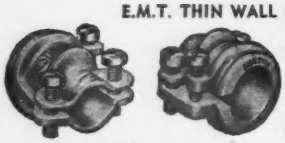
American Hot Dipped Galvanized or Black Heavy Wall Conduit

Hot Dipped Galvanized Electrical Metallic Tubing (thin wall conduit)



Austin Double Bushed Armored Cable

E.M.T. THIN WALL CONDUIT FITTINGS



New No. 1004 No-Nut Box Connector for numbers 14-2, 12-2, 10-2, 14-3, 12-3 and 10-3 non-metallic sheathed cable. No locknut required. Simply slip into ½" knockout, tighten the screw and it is permanently wedged into place—cannot vibrate loose.

Female insulated bushings. Sizes ½" to 6". Shallow or deep type

Male insulating bushings. Sizes ½" to 4". With or without locknut.

Insulating disc, either blank or with drilled holes for cable.

Insulating locknuts

SWITCH AND OUTLET BOXES AND COVERS

A complete line of outlet and switch boxes for every wiring system and to meet every wiring requirement. Made for use with heavy or thin wall conduit, armored cable, non-metallic sheathed cable, flexible steel conduit or flexible non-metallic tubing (loom). Also, a complete line of covers for each type and size of box.

Bar hangers for new or old work. Switch Box Supports for old or new work. Floor Boxes—Cast Iron Boxes, Bakelite Non-Metallic Switch and Outlet Boxes complete with covers.

AUSTIN REEL ROLLER

For dispensing any material that is wound on a reel—quickly, easily and safely. Reel revolves on ball bearing rollers with the greatest of ease—eliminates jacks and bar. Maximum capacity 4,000 lbs.

FARM LIGHTING

All the necessary fittings, even to the lag screws, are conveniently packed in a strong shipping carton, ready to be wired and installed. Nothing else to buy but the lamp. The detachable hood, wall bracket and flange are made of rustless aluminum and will not streak the side of the building. Saves time, material and installation cost.

AUSTIN WIRING SYSTEMS

The Austin line includes hot dipped galvanized or black enamel, heavy wall rigid conduit, hot dipped galvanized electrical metallic tubing, conduit, non-metallic sheathed cable, armored cable, flexible steel conduit and flexible non-metallic tubing, also wires and cables.

THIN WALL CONDUIT FITTINGS

Austin fittings for thin wall conduit includes connectors and couplings, adapters, short and long 90° connectors, straps, bending tools, wrenches, tubing cutter and holder, indenter tools, etc.

FENCE CONTROLLERS

There are five models of Austin fence controllers to meet all requirements. Straight six volts for use with storage battery, four dry cells or hot shot battery. Straight 110 volt high-line models, equipped with short signal light, three-point soil compensation, built-in lighting arrestor. Combination model for 6 volt battery and 111 volt high-line operation. Send for special bulletin.

ALL AUSTIN PRODUCTS ARE SOLD EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

CABLE BOX CONNECTORS AND FITTINGS

Austin cable box connectors come in no-nut type, ⅜" straight, also large [illegible] squeeze box connectors, universal two-screw, short elbow and panel extensions, universal for non-metallic and CNX cable, wedge box, duplex box, midget squeeze connectors. Also combination coupling, two piece angle style, cord and bare armored ground wire and universal 45° and 90° angle box connectors.

INSULATED END BUSHINGS AND DISCS

Austin insulating bushings are made to take heavy wall threaded conduit, also threadless types for thin wall conduit. Discs are blank, two-hole, three-hole designs. Combinations of discs and bushings can be ordered. Male-type insulating bushings come with locknut or without locknut. Locknuts available separately and composition insulating bushings with standard pipe threads.

SERVICE ENTRANCE FITTINGS

Austin service entrance fittings for rigid conduit, thin wall conduit grounding service elbows, one and two hole straps, end servetes, Y capped elbows, flanged type entrance head, still plates, floor plates, cable clips. Also hex-nut and two-screw water tight connectors, universal non water tight connectors, porcelain service caps and entrance cable hangers.

GROUND FITTINGS

Bondrite ground fittings for rigid or thin wall conduit, bare or armored ground wire, rigid and flexible types shunts, locknuts, bushings, ground meter rings, ground rods and all accessories.

CONDUIT FITTINGS

Bushings, locknuts, reducers, knockout closers, knockout reducers, wood plugs, various types of straps and hangers, floor boxes and accessories, unions, nipples, elbows, plugs. Write for details.

CONDUIT AND CABLE TOOLS

Rigid conduit hickeys and benders, thin wall conduit benders and cutters, tube holders, reamers, hack saws, wrenches, pipe gauge, wire gauge, two hundred types and sizes of screw drivers and mallets. Send for special bulletin.

LUGS, SPLICING, SLEEVES

Solder and solderless lugs wedge grip connectors, solderless service connectors, solderless fixture connectors, splicing sleeves (split, figure eight, double and oval single tube), set screw connectors, fuse clips, battery clips.

TIME SWITCHES

Austin time switches are available in many types, slow speed, self-starting, self-lubricating, synchronous motors. Standard indoor model has straight on and off controls, also heavy duty and O.D, one day program, SD seven day dial calendar types.

Entrance caps for heavy or thin wall conduit.

No. 1580 Patented flanged type entrance head.

Entrance Caps for all sizes of service entrance cable, in aluminum or porcelain.

No. 1539

Two-Screw Watertight Connectors

Hex-Nut Connectors

Sill plates with or without duxseal compound.

Non water tight connectors.

GROUND FITTINGS

For rigid or thin wall conduit.

For bare copper wire.

For bare armored ground wire.

Ground rods and point-n-cap.

CONDUIT FITTINGS

Bushings

Locknuts

Messenger wire hangers for heavy or thin wall conduit.

Reducers

Elbows

Straps

CONDUIT AND CABLE TOOLS

Thin wall conduit benders

Solderless and solder type copper lugs.

Solderless service connectors.

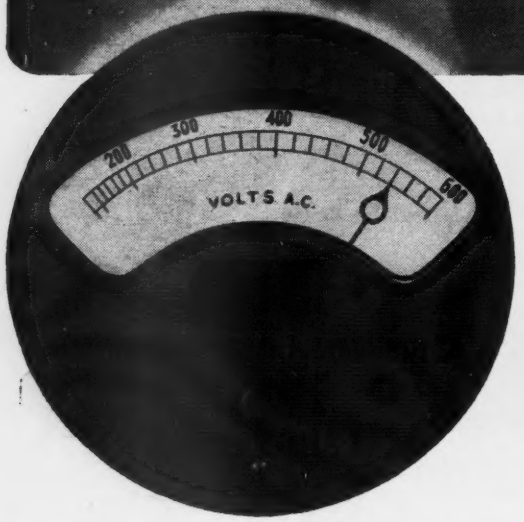
Time Switches

Klip-Klump forces fuse clips together for tight contact. For ferrule or knife blade. Fuses.

ALL AUSTIN PRODUCTS ARE SOLD EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Avoid dangerous arcs. Use

Laboratory Tests Prove The "Hidden Values" of Safety and Efficiency of *Vacu-Break* Safety Switches, Compared With Ordinary Enclosed Switches.



1 In the test set-up, an ordinary enclosed switch and a Vacu-Break Safety Switch are connected in parallel so that either switch can be used to make or break a 30% power factor load of 50 AMPERES, 540 Volts. This power factor approximates the condition prevailing in the case of a motor with a stalled rotor.

2 An arc of considerable size and duration, with accompanying flames of dangerous magnitude and intensity is produced when the circuit is ruptured with the ordinary enclosed switch. In this case an extension operating handle was used as an extra precaution. (Keeping the camera open to catch the arc flash produced a phantom picture of the operator's arm as the switch handle was moved to the OFF position to break the circuit.)

Use Vacu-Break safety switches

DON'T take risks in your plant! Get the positive protection of BullDog VACU-BREAK Safety Switches. Their quick-acting Clampmatic Contacts, "tight as a bolted connection," and the exclusive Bakelite Arcing Chamber that snuffs out dangerous arcs safely and instantaneously, insure long, trouble-free switch life.

For these authentic test pictures show that even with as small a load as 50 AMPERES, dangerous power arcs can develop on motor circuits under stalled rotor conditions or on welding circuits or similar types of inductive loads.

In such cases, with ordinary enclosed switches a large open arc can jump to a pole of opposite polarity or to the steel switch enclosure causing a dangerous short circuit power arc.

So avoid all such hazards to your personnel and property and minimize pitting and arcing of contacts which lead to eventual break-downs by always specifying —VACU-BREAK—when ordering safety switches.

• • •

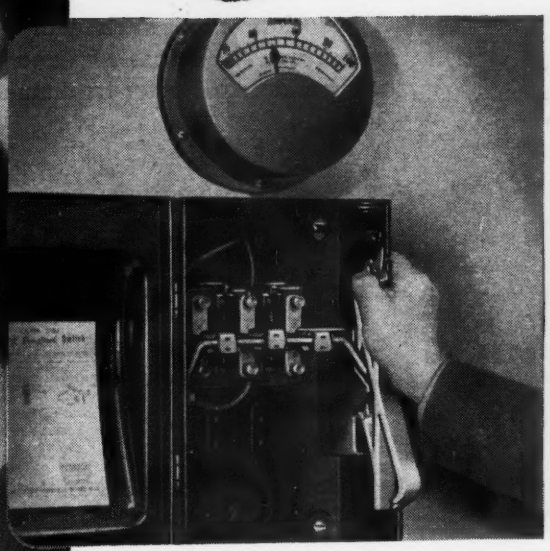
BullDog Also Manufactures BUStribution DUCT—Switchboards—Panelboards—Circuit Master Breakers Industrial Trol-E-Duct for Portable Tools, Cranes, Hoists—Universal Trol-E-Duct for totally flexible lighting.

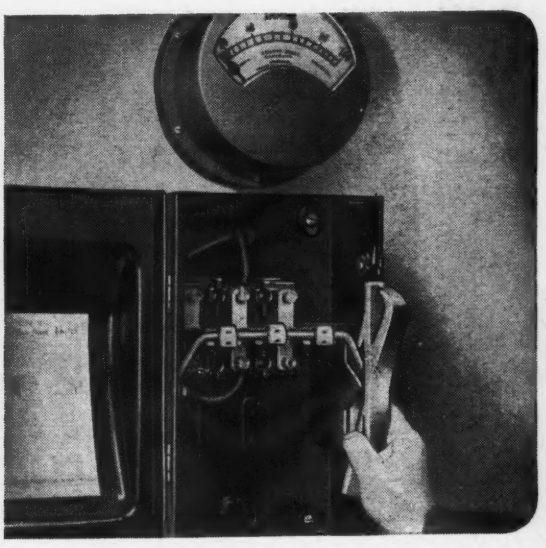
BULLDOG

ELECTRIC PRODUCTS COMPANY

DETROIT 32, MICHIGAN

In Canada: BullDog Electric Products of Canada, Ltd., Toronto. Field Offices in All Principal Cities.





3 **The arc is barely visible** when the circuit is ruptured with the VACU-BREAK Safety Switch under the same conditions (but without the precaution of the extension operating handle). Two photos, showing the VACU-BREAK Switch at the instant of opening and closing, differ only in the position of the handle and the operator's hand and the position of the ammeter needle.

BRYANT WIRING DEVICES

THE MASTER LINE FOR EVERY MASTER SPECIFICATION

Leading Architects, Engineers and Contractors specify "BRYANT" — For quality, economy and long life

FLUSH WALL SWITCHES

No. 5431

Cat. No.	Description	AMPERES. 125 Volts	250 Volts
5431	Single Pole, Indicating	30	30
5432	Double Pole, Indicating	30	30
5433	3-Way	30	30
5434	4-Way	20	10
5861	Single Pole, Indicating	20	20
5862	Double Pole, Indicating	20	20
5863	3-Way	20	20

Fit standard deep switch boxes, single gang, and standard wall plates. Recommended for heavy duty 30 ampere circuits in industrial, commercial and institutional buildings. Totally enclosed in bakelite casings. The No. 5861 20 ampere line of switches are of shallow cup design permitting installation in 1½" boxes. Mechanisms are insulated from yoke and are fully enclosed in rugged bakelite housings.

No. 4961

4961	Single Pole, Indicating	10	5
4962	Double Pole, Indicating	10	10
4963	3-Way	10	5
4964	4-Way	5	2

Specially formed, silver plated contacts assure long life at full rated loads. Totally enclosed. Meets all government specifications. The correct switch for banks, industrial plants, hospitals, schools, fine residences, offices buildings and theatres.

No. 3951

3951	Single Pole, Indicating	10	5
3952	Double Pole, Indicating	10	10
3953	3-Way	10	5
3954	4-Way	5	2

A porcelain cup switch with operating features which make it desirable for apartment, residential, commercial and other medium-duty applications.

No. IL-1311

IL-1311	Single Pole, Indicating	10	5
IL-1312	Double Pole, Indicating	10	10
IL-1313	3-Way	10	5
IL-1314	4-Way	5	2

"Interchangeable" switches, designed so that as many as three switches, pilot lights, etc. may be installed in any desired combination under a single gang plate. Excellent for residential and commercial jobs wherever space economy is important.

NOTE: For lock type, add "L" to any of above catalog numbers. Standard handles are brown. Ivory handles furnished when specified. "T" rated at 125 volts.

THE BRYANT ELECTRIC COMPANY • BRIDGEPORT 2, CONNECTICUT

NEW YORK 17	CHICAGO 7	SAN FRANCISCO 3	LOS ANGELES 13
101 Park Ave.	844 West Adams St.	525 Eighth St.	420 South San Pedro St.

FLUSH RECEPTACLES

No. 4832

No. 4832 Duplex

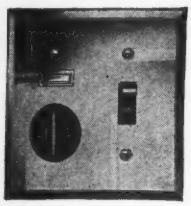
A reliable receptacle totally enclosed in bakelite and with "T" slots, double sided spring contacts and wide mounting yoke. Meets requirements of best specifications.

No. IL-1320

No. IL-1320

An "Interchangeable" receptacle: as many as three may be used in one gang or they may be combined with interchangeable switches shown on preceding page.

SWITCH RECEPTACLE and PILOT

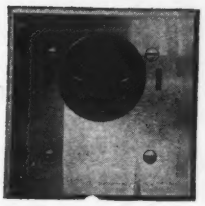


No. 55350

No. 55350

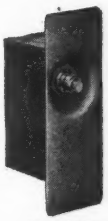
Ideal device for residences, apartments, institutions, hospitals, banks, etc. Light indicates that switch controlled receptacle is in use. Combination with 125 volt lamp and .040" brass plate.

RESIDENTIAL SPECIALTIES



No. 3846

Specify Bryant No. 3846 Flush Range Receptacle with .040" plate. Provides convenient range connection and range can be removed at any time without requiring services of an electrician. For surface installations specify No. 3826.



No. 2968

Door switches save money as lights can never be left burning in closets with this device on guard. No. 2968 if light is to be "On" when door is open: No. 2969 if light is to be "OFF" when door is open. Supplied complete with outlet box.

No. 4275

Specify Bryant Outlet Box Lamp Receptacle for closets, attics, basements, garages, etc. Also desirable for commercial and industrial use. Available in keyless and pull chain types for 3¼" or 4" outlet boxes.

FLUSH WALL PLATES

You can safely specify "Bryant" no matter what your wall plate requirements. Plates are made in .040" and .060" brass or in bakelite. They may be engraved with letters or numbers. And Bryant will plate, lacquer or enamel any wall plate to match building hardware, marble or other decorative architectural features. Bryant makes multiple gang plates for any desired combination of switches, receptacles, bull's eyes or other flush wiring devices.

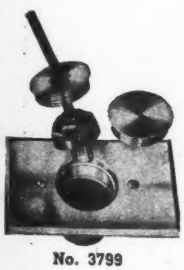
SPECIAL USE RECEPTACLES

No. 2828

No. 2828 Clock Hanger Outlet complete ready for installation. Clock hangs from hook and receptacle is used for the cord and plug and completely conceals both when clock is in place. A real necessity in kitchens, halls, living rooms; in offices, libraries, stores, public buildings, institutions and banks.

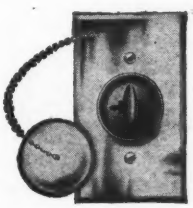
No. 3750

No. 3750 Fan Hanger Outlet complete with plate and mounting yoke. This device should be installed wherever a fan is likely to be used. In offices, hotel rooms, residences, apartments, auditoriums, public buildings, institutions, banks.



No. 3799

No. 3799 Floor Outlet complete, ready for installation. Designed particularly for residential and apartment installation.



No. 3880

No. 3880 Outdoor Receptacle complete with quick clamp cover, rubber mat. Permanently weather-proof, this device is ideal for residential jobs, for outdoor terraces, decorative lighting, porches, etc., and for general industrial and commercial outdoor applications.

Specify "Bryant". There is a Bryant device for every requirement. For complete information, see Catalog No. 40.

THE BRYANT ELECTRIC COMPANY • BRIDGEPORT 2, CONNECTICUT

NEW YORK 17	CHICAGO 7	SAN FRANCISCO 3	LOS ANGELES 13
101 Park Ave.	844 West Adams St.	525 Eighth St.	420 South San Pedro St.

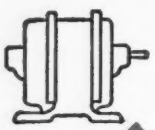
Save Space · Save Money-

in Panelboards and Switches

You can get fuller use out of every switch or panelboard on Motor Circuits by Installing Fusetrons. The tremendous time-lag of Fusetrons permits them to hold starting currents or other harmless overloads. Hence they can be used in sizes nearer to the actual *operating* load of the circuit.

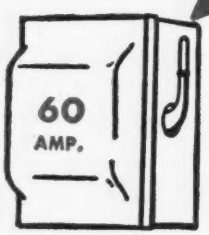
Ordinary fuses have little time-lag. To keep them from opening on starting currents they must be used in sizes much larger than the actual operating load. This means that OVERSIZE equipment must be provided for them.

To get a picture of what Fusetrons can do for you let's take a 15 amp. motor as an example. Then you can figure the advantage of installing Fusetrons on all your circuits



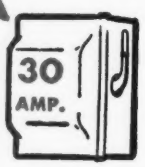
15 amp Motor

With ORDINARY FUSES
a 60 ampere switch is commonly installed because 45 ampere fuses must be used to hold the motor starting current



OVERSIZE
Switch or panelboard

PROPER SIZE
Switch or panelboard



With BUSS FUSETRONS
a 30 ampere switch is installed because on normal installation, 15 ampere Fusetrons can be used. They will hold the starting current of the motor

Think What Fusetrons Can Mean to You in Saving Space, Time and Money

On NEW installations

You can use Fusetrons in sizes smaller than would be possible with ordinary fuses. This means you can SAVE SPACE because you install smaller size switches and panelboards.

Saving space often permits you to locate switches and panelboards in more convenient spots than would be possible if ordinary fuses or other protective devices were used

You also get some additional saving on fuse replacement costs because small size Fusetrons generally cost less than larger size fuses

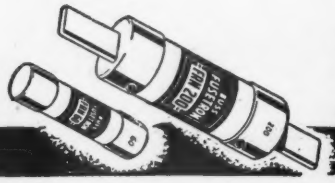
On PRESENT installations

If you want to increase the size of a motor on a circuit—or add more motors—Fusetrons can often save you the cost of installing a larger switch or panelboard. Fusetrons hold starting currents, hence permit a great increase in the actual running load on the switch or panel.

Instead of tearing out your present switch or panel you just replace the ordinary fuses now in it with Fusetrons.

Often too, this saves the trouble and worry of looking for a spot to locate OVERSIZE equipment required by ordinary fuses or other protective devices.

Fusetrons give you a chance to *get full use* from every switch and panelboard in your plant



BUSS

Get Better Protection

With BUSS FUSETRONS

PROOF

Fusetrons saved money for a large Chemical Company in Michigan

Says the Vice President in charge of production, "several months ago we changed the motor on an induced-draft fan in our plant from 50 h. p. to 75 h. p..

A 200 ampere switch was already installed and there was really no place for a larger switch.

Our Electrical Engineer solved the problem by installing Fusetrons in the 200 ampere switch, thus saving the expense of buying a larger switch.

The old switch with the Fusetrons operates entirely satisfactorily—there has not been a single blow."

It may save you money and space to remember this experience the next time you must increase a motor load—or make a new motor installation.

WHAT IS THE FUSETRON?

The Fusetron is a DUAL element device—a Fuse to which is added a Thermal Cutout.

The result: a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have same degree of Underwriters' Laboratory approval for both motor-running and circuit protection as the most expensive devices made.

Fit standard fuse clips

Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.

They are obtainable in all sizes from 1/10 to 600 ampere in both 250 and 600 volt types. Also in tamper-resisting type (Fustats) for 125 volt circuits.

Their cost is surprising low

Get All the Facts

Get Better Protection—Send the Coupon Now

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons.

BUSSMANN MFG. CO., ST. LOUIS 7, MO.
Division McGraw Electric Co.

Get Many Kinds of Protection Heretofore Not Available by Installing Fusetrons Throughout the Electrical System

★ ***Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.***

Fusetrons have tremendous time-lag. They hold 500% load more than 10 seconds whereas most sizes of ordinary fuses blow in less than one second. They won't open on starting currents or harmless overloads (heavy overloads for a short time or light overloads for a longer time). Fusetrons won't shut down a circuit needlessly. They open only when something goes wrong.

★ ***Give Thermal Protection to Panelboards and Switches.***

The thermal cutout in the Fusetron will open whenever its temperature reaches 280° F. Thus if poor contact heat develops from any cause the Fusetron cuts off the current before damaging temperatures can be reached. Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

With Fusetrons you are warned that a minor maintenance job is needed instead of having panel or switch damaged or destroyed by poor contact.

★ ***Prevent needless blows caused by heating in panels and switches.***

Ordinary fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat and thus eliminate useless shutdown troubles caused by fuses running too hot in panelboards and switches.

★ ***Permit use of larger motor or adding more motors on circuit without installing larger switch or panel.***

See other page.

★ ***On new installations proper size switches and panels can be used instead of oversize.***

See other page

★ ***Protect motors against burnout.***

On normal installations, Fusetrons used in a size near ampere rating of motor will protect it against burnout from lack of oil, worn bearings, tight belt or anything that causes a dangerous electrical overload—yet their tremendous time-lag keeps them from blowing on motor-starting current.

★ ***Give double burnout protection to large motors.***

Larger motors already equipped with overload protection sometimes burn out due to thermals or relays failing to operate. Replace fuses used for short-circuit protection with Fusetrons of size near motor rating and they will protect motor against burnout from any electrical overload, entirely independent of other overload device.

★ ***Provide simplest way to stop burnouts from single phasing.***

When single phasing occurs, increased current flowing through remaining phase will open Fusetrons (if size used is near normal running current of motor) and shut down motor. Never before has such dependable single phasing protection been available.

★ ***Make burnout protection of small motors simple and inexpensive.***

Small motors have generally been operated without burnout protection because the cost of protecting them has been too great compared to cost of replacing motor. Now for the little cost of installing a Fusetron of proper size, any motor can be given safe, dependable burnout protection.

★ ***Protect coils, transformers and solenoids against burnout.***

Install a proper size Fusetron. It won't open on harmless overloads or normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

946

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

EC-9-46

Name_____

Title_____

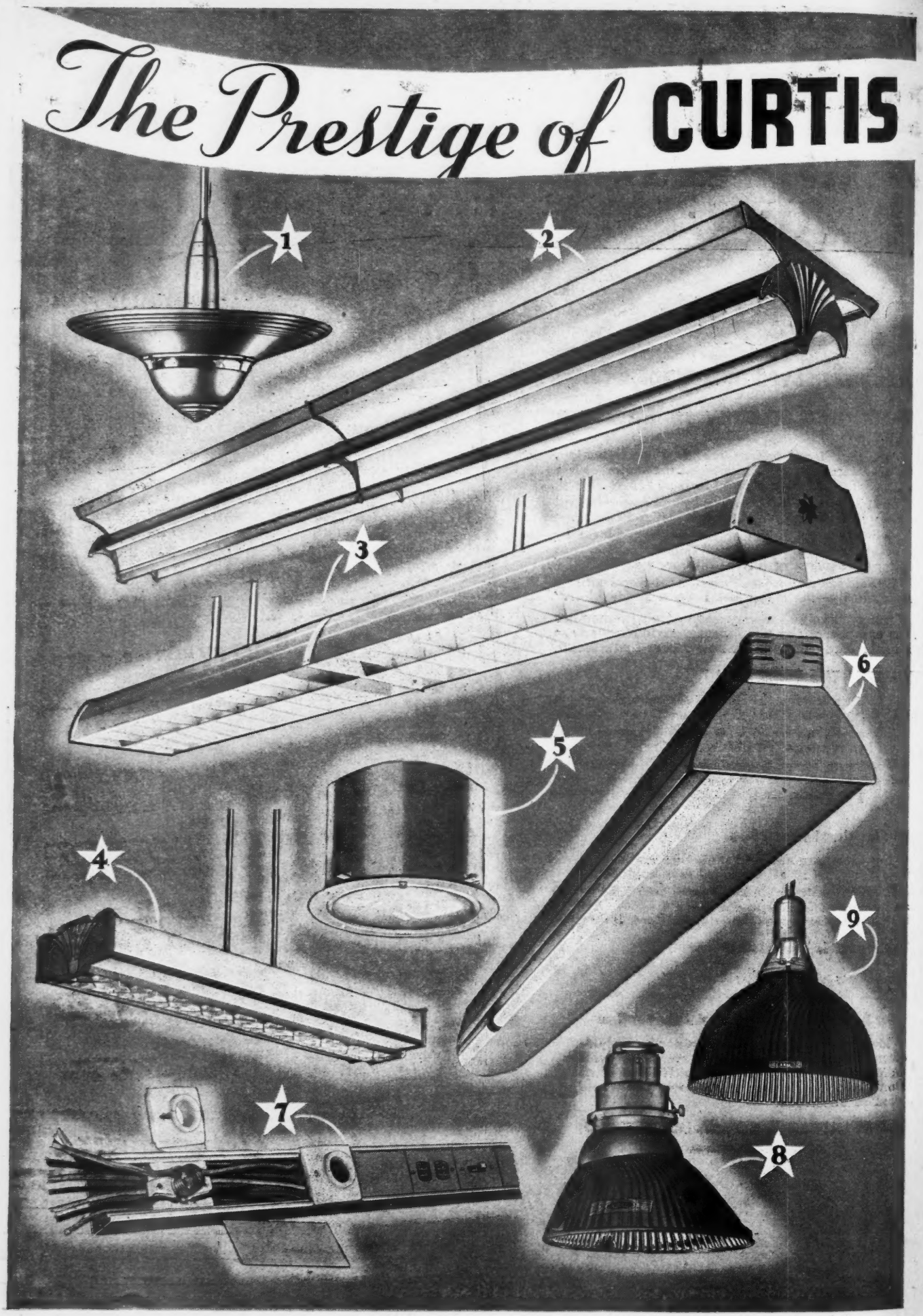
Company_____

Address_____

City_____ State_____

FUSETRONS

Sold Through Wholesalers


The Prestige of CURTIS
1
2
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9

BACK OF EVERY UNIT

Study These Characteristics of Quality

1 CAT. No. 5090

"Winner" indirect lighting luminaire for 500- or 300-watt PS lamp. Suspension 36". Bowl diameter, 19½". Made of aluminum throughout. Finished in Satin Gray. "X-Ray" Silver Mirror Reflector is concealed in the bowl of this unit.

2 CAT. No. 895-C

TWIN SKYLUX is for two 40-watt fluorescent lamps per four-foot section. Cat. No. 895-C complete four-foot unit. Cat. No. 896-C Extension Section, to make continuous luminaries. For store and office lighting. These units are quality fixtures, rugged and efficient, remarkably easy and inexpensive to maintain.

3 CAT. No. 4060-C

The "Forty-Sixty" is designed for eye-comfort. The low brightness of the satin finish Alzak Aluminum reflectors and louver fins blends with the illuminated ceiling producing a comfortable field of vision. The ceiling is illuminated by an indirect component of approximately 40% of the light output. The 60% direct component is louvered to produce 35° crosswise and 25° lengthwise shielding. Recommended for offices, schoolrooms, etc. Uses two 40-watt lamps. Pendant mounted either as individual four-foot units or continuous lines.

4 CAT. No. 1400

STARLUX is an attractive luminaire of high overall efficiency, available as an individual pendant unit or in continuous runs. Finish Satin Gray with white Fluracite louver, diffusing crystal glass panels.

5 CAT. No. 2309

Round deep metal housed recessed unit, with "X-Ray" reflector, for 300-watt PS lamp. Diameter of lens 14". Depth for recessing, 15¼". Catalog No. 2306 for 200-watt lamps. Diameter of lens 10". Depth for recessing, 12⅜". Write for information on other recessing units and fittings.

6 CAT. No. 940-C

FLUORESCENT CURTISTRIP, Cat. No. 940-C, is deep (semi-concentrating type) reflector illustrated. Cat. No. 944-C, shallow (distributing) type. Cat. No. 948-C, asymmetric (directional) type for lighting vertical surfaces. Single lamp 20-watt, 30-watt and 40-watt fixtures and continuous runs in multiples of two feet. Made of steel. Reflectors finished snow-white Fluracite. Channel finished Satin Silvertone.

7 CAT. No. 1-A

CURTISTRIP WIRING CHANNEL cross section is 2½" x 1⅝". The patented flat snap-in cover permits outlets to be installed on any spacing. Cat. No. 1-A, channel only, 10 ft. lengths; Cat. No. 1-B, cover only, 10 ft. lengths; Cat. No. 5, standard porcelain socket with shade holder groove, for use with show window reflectors, including No. 530 and 420. Cat. No. 5-A, special porcelain socket for use with "X-Ray" screw engaging holders only. Cat. No. 9, strap for holding CurtiStrip against any flat surface. Cat. No. 21, switch plate, takes standard toggle switch (switch not included). Cat. No. 23, duplex receptacle plate, takes all standard receptacles (receptacles not included).

8 CAT. No. 530

"X-Ray" Show Window Reflector, attraction-zone type for shallow windows, 300- or 200-watt medium base. Cat. No. 420 "X-Ray" Show Window Reflector, attraction-zone type for shallow windows, 150-watt size.

9 CAT. No. 589

"X-Ray" Silver Mirror industrial reflector, for 750-1000-1500 watt PS and 400-watt Mercury Vapor lamps. Cat. No. 1589, same as 589 but protected by a metal housing. Cat. No. 588, similar to 589 but 500- or 300-watt size. Cat. No. 1588, similar to 588 but protected by a metal housing.

CURTIS REPRESENTATIVES

ATLANTA, GA. . . . . W. T. Woods, Jr., 231 Healy Bldg.
BALTIMORE 2, MD. . . . . T. H. Bailey, Jr., 614 Garrett Bldg.
BOSTON, MASS. . . . . L. S. Cooke, 436 Webster Street (Needham Heights 94)
CHICAGO 6, ILL. . . . . Sales Office, 600 West Jackson Blvd.
CINCINNATI 8, OHIO. . . . . J. W. Morrison, 2618 Erie Avenue
CLEVELAND 15, O. . J. W. Shively, Room 402 Swetland Bldg.
DALLAS 1, TEX. . . . . Fred H. Simmer Co., 103 Thomas Bldg.
DENVER 2, COLO. . . . . H. M. Olmstead Co., 1534 Wazee St.
DETROIT 26, MICH. . . . . C. H. Burch, 424 Book Building
INDIANAPOLIS, IND. . . . . H. J. Damm, 20 South Capitol Ave.
KANSAS CITY 3, KAN. . . H. B. Ewert, 5228 Canterbury Road
MILWAUKEE 2, WIS. . . . . H. Q. Beven, 759 N. Milwaukee St.
MINNEAPOLIS 2, MINN. G. M. Felland, 220 South 10th Street
NEW ORLEANS 12, LA. . . . . W. J. Keller, 304 Natchez Bldg.
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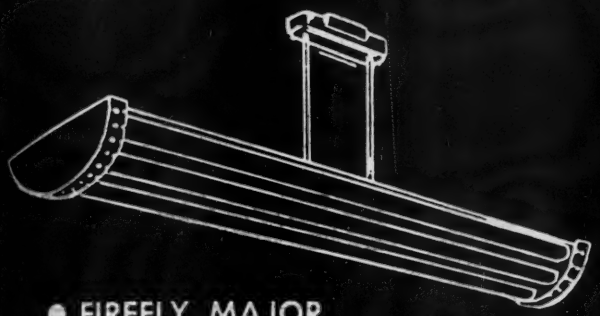
ST. LOUIS 1, MO. . . . . G. C. Law, 313 N. 9th St.
SAN FRANCISCO 2, CAL. . . . J. D. Erickson, 100 Hermann St.
SEATTLE 1, WASH. . . . . W. K. Turner, Terminal Sales Bldg.

CURTIS *Lighting*, INC.

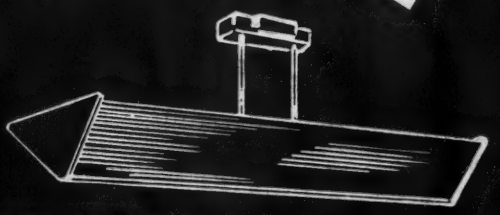
6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

Firefly Line*



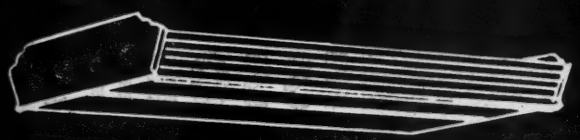
● FIREFLY MAJOR

Firefly Major, all purpose commercial units, offer maximum illumination. These 2 and 4 lamp models are easily installed individually or in continuous rows, flush or pendant hanging.



● COMMANDER

This V-type glass covered commercial unit has outstanding service features. The panels can easily be removed from below without removing fixture ends. Designed either in pendant or flush to the ceiling mounting—special end spacers must be specifically ordered for continuous installation.

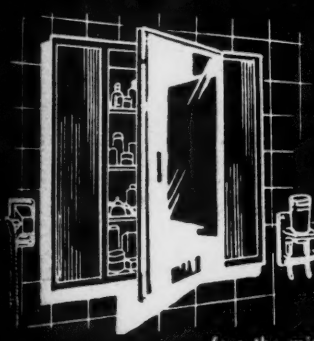


● FIREFLY STREAMLINER

This Firefly 4-40 watt URC type fixture, provides high intensity diffused light of superior quality and low brightness. It has side panels of Stylex glass and bottom of ribbed Skytex glass. The unit is adaptable for every type of installation, pendant hanging or flush to the ceiling in individual or continuous rows.

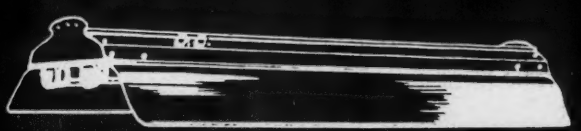
● INDUSTRIAL-LITE

The Industrial-Lite, a 4 ft. unit available in 2 or 3 lamp models. It has a reflecting factor of between 85 and 90%. Units are completely wired, ready to install with direct-to-ceiling or stem mounting. Knock-outs in channel for conduit at several locations.



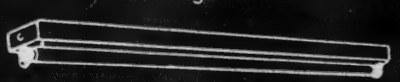
● FIREFLY BATHROOM CABINET

Fluorescent lighting and auxiliaries are actually constructed into the cabinet itself. Concave built-in reflectors on both sides of the cabinet project intense fluorescent light, which is refracted through attractive Skytex glass panels. Standing before the mirror your face is evenly and softly illuminated so that it can be distinctly seen in the mirror without objectionable glare. The side light sources from the fluorescent lamps, concealed behind the cabinet mirror door makes a beautifuliy modern and simple bathroom unit, which is designed to be recessed into any standard wall. Requires 30⅜ inch horizontal wall opening, 3$\frac{5}{16}$ inch depth from face of plaster into wall and 24⅜ inch vertical opening.



● SUPER INDUSTRIAL LITE

A highly streamlined and skillfully engineered and improved industrial unit for chain, flush and track or continuous mounting.



● CHANNEL LITE UNITS

Channels are available in low power factor 40 and 20 watt sizes and in a 15 watt chrome decorative strip with switch and convenience outlet.

MFG. CO. INC.

MILWAUKEE 5, WIS.

All fixtures are constructed of heavy gauge steel with baked finishes of the highest quality enamels available—Underwriters Laboratory and IBEW label. All units (except channel lights) are high power factor, 60 cycle, 120 volt A.C. unless otherwise specified.

COLD CATHODE

Now

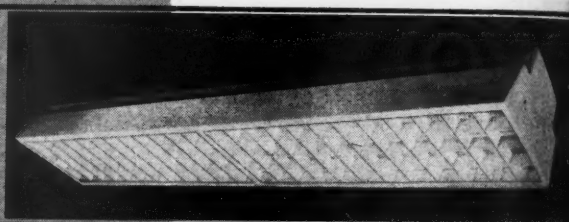
ZEON

FEDERAL STRIPLITE BASE

AND INTERCHANGEABLE ACCESSORIES

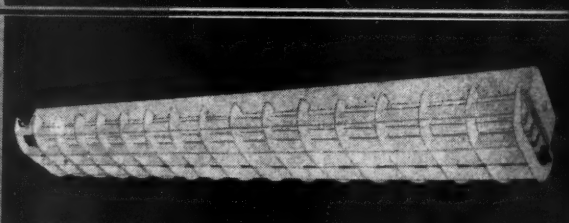
May be used as an open troffer or with flat louvers or diffusing "Sky-Tex" glass panels. An opening between the hood and the Striplite permits light to be reflected to the ceiling as well as downward. Suitable for surface or suspension mounting.

HOOD ACCESSORY



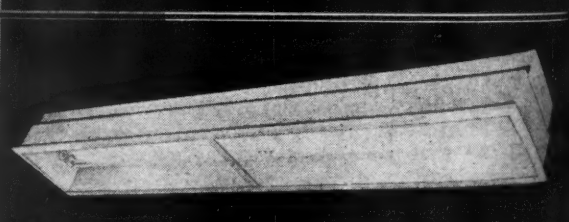
Attractive curved louvers, for those who prefer partially concealed lamps, reduces brightness contrasts with minimum loss of efficiency. Louvers have hinging action for lamp accessibility. Suitable for surface or suspension mounting.

CURVED ACCESSORY



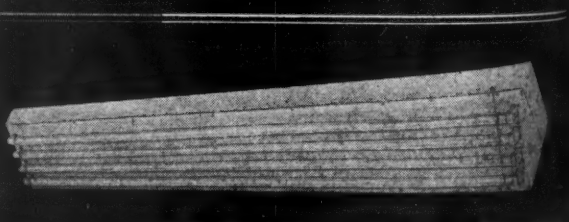
Ideal for that recessed installation. Reflector easily detachable for cleaning without disturbing sockets or wiring. May be used open or with flat louvers or diffusing "Sky-Tex" glass panels.

FLUSH ACCESSORY



Show windows properly illuminated. A maximum for display, with a minimum of outside "spill." For "quotation" boards, and neat appearance on beamed ceilings, too. Suitable for surface or suspension mounting.

ANGLE ACCESSORY



Produces OVER 30 FIXTURE

FEDERAL ELECTRIC

simplified INSTALLATIONS

LESS TO STOCK!

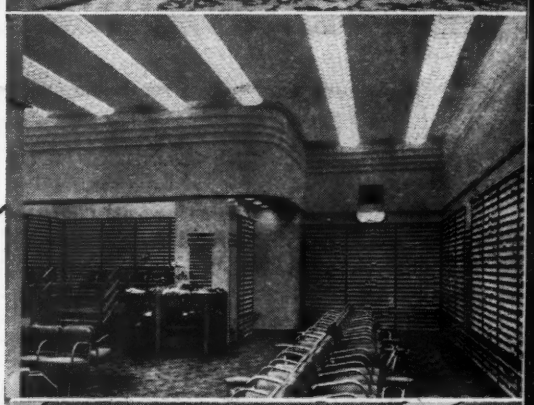
Striplite bases contain all ballasts, sockets, and wiring. Accessories are completely interchangeable in the respective fixture sizes. A complete line of fixtures without duplicate stock of expensive parts or waste of warehouse space.

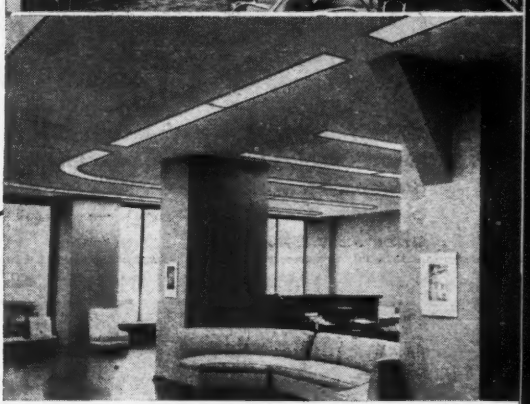
MORE TO SELL!

Long life and low depreciation of cold cathode lamps assures efficient operation with low maintenance costs. Appearance of installation may be completely changed without touching electrical connections by simply adding or substituting another accessory. Also: 1, 3, or 5-lamp units may be increased to 2, 4, or 6 lamps, respectively, by exchanging the socket plates and ballasts. Fixtures need not be removed.

EASIER TO INSTALL!

Convenient knockouts in all raceways are provided, for electrical connections, or suspension mounting. In all cases, Striplite sections mount independently, and accessories are added. Weight and bulk are thus reduced to a minimum. All electrical connections are completely accessible before, during, and after installation.





Dualite

Curvelite

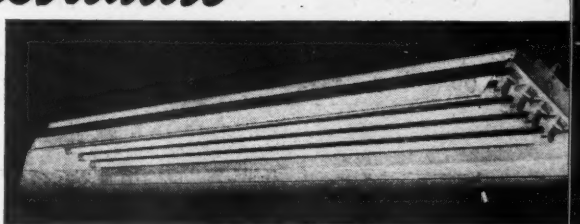
Flushlite

Anglelite

TYPES

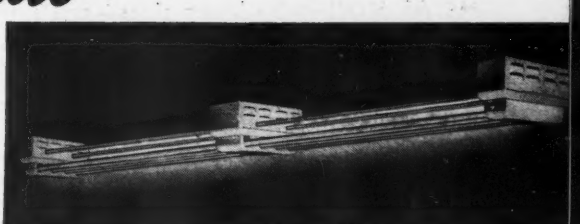
Industrialite

Extremely high reflector efficiency—over 91% in 4-lamp unit. May be installed as single 8′ units or in continuous rows. One single outlet will service 72′ of 4-lamp units.



Streamlite

Ultimate in simplicity—for stem or surface mountings. Minimum of fixture bulk, sockets and ballast concealed in easy to mount housings. May be used in continuous rows to reduce service wiring requirements. Only one outlet required for 72′ of 4-lamp units.



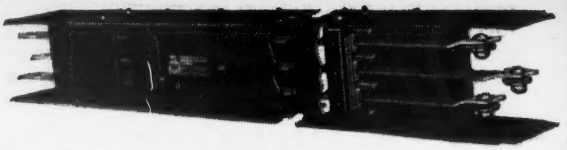
Lamps and fixtures fully guaranteed for one year (except lamp breakage). Available for immediate delivery. Ask your jobber or write to the Federal Electric Co., Inc., 8700 S. State St., Chicago 19, Illinois.

COMPANY, INC., CHICAGO 19, ILL

NATIONAL

The *COMPLETE* Line of Raceways

SHERARDUCT—Permanently rust-proof, heavy walled, threaded, rigid steel conduit. Bends without cracking . . . smooth inside. Highest quality conduit available. Zinc protective coating alloyed to the steel . . . will not crack or peel.



BUS—IPI Plug-In and IFB Feeder Bus for industrial and commercial systems. Plug in or disconnect loads anytime without interrupting service. Complete with plug-in devices and accessories. Fireproof and dust tight. Rugged construction . . . high salvageability.

XDUCT JUNIOR—High-quality, rigid, thin wall, Electric Metallic Tubing protected by an electro-galvanizing process that produces a smooth coating of zinc. Provides "pull-in"— "pull-out" facilities after installation.

WIREWA—An enclosed 4" x 4" wireway. Hinged, spring-latch covers provide instant access. Easy to install by suspension or direct mounting. Approved for feeder, branch circuits, control and signal wiring up to 600 volts.

FLEXSTEEL—Galvanized, flexible steel conduit . . . Continuous runs from outlet to outlet minimize fitting requirements . . . saves time and money. Provides "pull-in"—"pull-out" facilities and continuous grounding. Smooth inside surface makes fishing easy.

NEPCODUCT—The modern underfloor wiring system for power, light and communication circuits. Saddle supports simplify installation and provide means of leveling duct. Variable-height outlets are readily accessible. Service fittings sturdily constructed.

METAL MOLDING—Three sizes—one principle—"lay-in the wires." Interconnectable fittings facilitate all installation requirements. Lay-in the wires, snap on the capping—NO FISHING NECESSARY. Permits quick changes or additions.

SURFACEDUCT—A 2-piece raceway, 2" x 2", for every type of service up to 60-amp. loads. Lay-in the wires . . . snap on the capping. Device-covers accommodate over 300 approved manufacturers outlet devices. Ingenious bridge securely locks capping.

PLUG-IN STRIP—A simplified, revolutionary, 2-wire or 3-wire Plug-In Strip . . . provides electrical outlet service every 18 inches . . . 3-wire Strip makes every outlet simultaneously "hot" or switch-controlled.

FLORDUCT—A 2-piece surface raceway for low or high potential service across floors. Low sloping ramp design hugs the floor with minimum obstruction. Withstands general office traffic, including hand trucks.

ELECTRIC

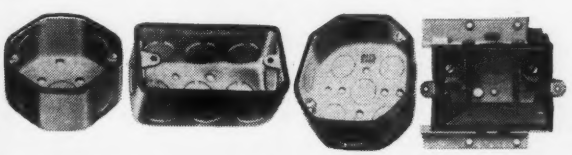
Wires, Cables and Fittings

DILEC FIRESTOP WIRE AND CABLE, ALSO TYPES T AND TW—Colored insulated wire for all purposes. Smooth, free-stripping . . . offers the electrician a clean handling, patent-leather-like finish that does not rub off . . . Marked . . . Measured.

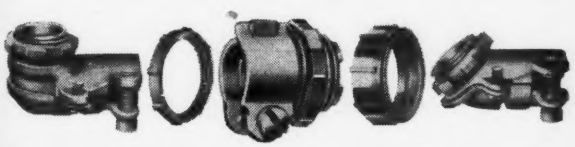
PARKWAY, VARNISHED CAMBRIC, ASBESTOS AND INDESTRUCTO CABLE—There is an NE wire or cable of the required size, stranding, insulation and sheathing to meet the requirements and electrical characteristics of every job.

A. B. C. (Armored Bushed Cable)—Dilec Firestop insulated conductors—moisture- and flame-resistant—kraft wrapped and protected with galvanized, flexible-steel armor. Anti-short bushing protects conductors against sharp cut edges of steel. A.B.C. is also made with Type T NE'on insulated conductors.

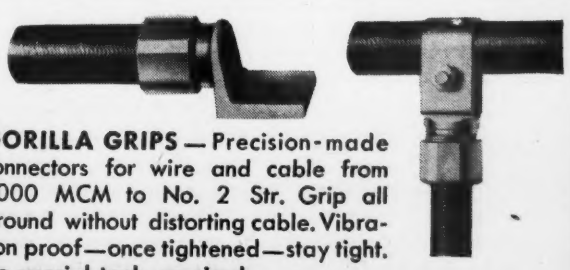
LOOMWIRE—Non-metallic sheathed cable. Conductors are Dilec Safecote insulated and kraft wrapped. Sheath is heavy, tough, flame- and moisture-resistant. The only non-metallic sheathed cable with complete line of fittings. Loomwire is also made with Type T NE'on insulated conductors.



"REDEGE" Outlet and Switch Boxes—Strong, well-made boxes, clean knock-outs, true edges, unique cable and wire clamps. A style for every type of conductor and kind of device.



FITTINGS—NE fittings are made of malleable iron and high grade stamped steel . . . smooth inside and outside. Well-formed threads . . . uniform pressures for secure grounds. There's an NE fitting for every purpose—every kind of job—every type of wiring.



GORILLA GRIPS—Precision-made connectors for wire and cable from 2000 MCM to No. 2 Str. Grip all around without distorting cable. Vibration proof—once tightened—stay tight. No special tools required.

NATIONAL
ELECTRIC PRODUCTS
NE
WIRING SYSTEMS
WIRES AND CABLES

NE Products specified assure quality installation.

Engineered to fit the job!

National Electric
PRODUCTS CORPORATION
Box 897 — Pittsburgh 30, Pa.

All National Electric roughing-in materials are listed and approved by Underwriters' Laboratories, Inc. Distributed through leading electrical wholesalers.

ILLINOIS

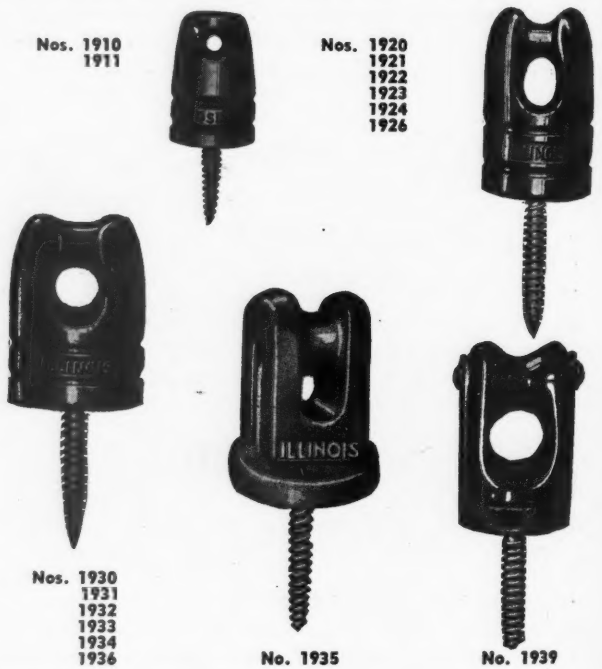
COMPLETELY INSULATED

ALL PORCELAIN WIRING SYSTEMS . . .

Always the Answer for QUALITY WIRING JOBS . . .

WHEN you use Wireholder Insulators with the name "ILLINOIS" you are backing your work with the right quality for the job. It offers the best and safest method for making house service connections. Porcelain is of best dry-process manufacture — amply strong for any consumer service. All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by the Watrous process of centrifugal galvanizing to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements.

PORCELAIN WIREHOLDER INSULATORS



Insulator No.	Size of Screw or Bolt	Type of Screw or Bolt	Dimensions of Insulators, Inches			Wgt. per 100
			Diam.	Hgt.	Hole	
1910	No. 16 x 1½"	Cadmium Plated steel wood screw	1⅜"	2"	⅜ x 1"	40
1911	No. 16 x 1½"	Brass wood screw	1⅜"	2"	⅜ x 1½"	40
1920	No. 22 x 2"	Hot Galv. steel wood screw	1¹³⁄₁₆"	3"	⅝ x ¾"	65
1921	No. 22 x 2"	Brass wood screw	1¹³⁄₁₆"	3"	⅝ x ¾"	65
1922	No. 22 x 2"	Everdur wood screw	1¹³⁄₁₆"	3"	⅝ x ¾"	65
1923	⅝ x ⅝"	Hot Galv. stud for brackets	1¹³⁄₁₆"	3"	⅝ x ¾"	65
1924	¼ x 5"	Galv. Toggle bolt	1¹³⁄₁₆"	3"	⅝ x ¾"	80
1926	⅝ x 5"	Galv. bolt and nut	1¹³⁄₁₆"	3"	⅝ x ¾"	80
1930	No. 22 x 2"	Hot Galv. steel wood screw	2⅛"	3¼"	¾"	95
1931	No. 22 x 2"	Brass wood screw	2⅛"	3¼"	¾"	95
1932	No. 22 x 2"	Everdur wood screw	2⅛"	3¼"	¾"	95
1933	⅝ x ⅝"	Hot Galv. stud for brackets	2⅛"	3¼"	¾"	95
1934	¼ x 5"	Hot Galv. Toggle bolt	2⅛"	3¼"	¾"	100
1936	⅝ x 5"	Hot Galv. bolt and nut	2⅛"	3¼"	¾"	125

WHEN YOU SELL YOUR NEXT WIRING . . . . .
Sell **AN ALL PORCELAIN ILLINOIS SYSTEM**

SECONDARY RACK INSULATORS

Secondary Rack Insulators being an important link in the circuit naturally require the use of the highest quality of porcelain be used in the spool insulator.

The quality of the porcelain used in the Secondary Rack Insulators is as important as any other component in a complete installation. The illustration shows one type only. They are made in sizes ranging from 2″ diameter x 1⅝″ high, to 4½″ diameter x 4¼″ high.

PIN TYPE INSULATORS

Illustrated are three popular shapes of Pin Type Insulators. These are made in sizes 2⅛″ diameter x 2¾″ tall to 7″ diameter x 5¾″ tall for all of the standard voltages.

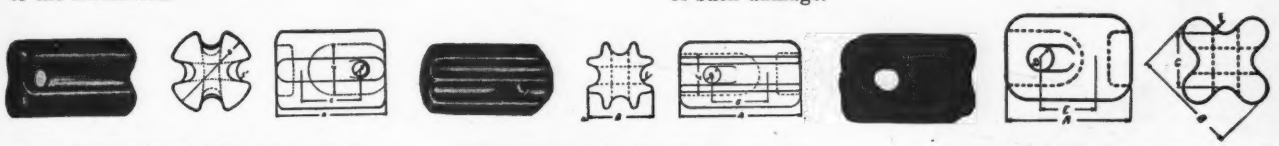
Illinois Pin Type Insulators are always made by the wet process method. Pin hole size is accurate to insure perfect installation.

GUY STRAIN INSULATORS

Illinois Wet Process Guy Strain Insulators are made from the same porcelain body as that used in Illinois line insulators. They are non-porous, and of high mechanical and dielectric strength. Brown glaze.

The values for mechanical strength given in table below are those obtained with hard-drawn copper or mild steel strand of the proper size to conform to the hole and grooves of the insulators.

The rugged design of the Standard Type makes it the least liable to mechanical damage by chipping. The X Type has a somewhat greater leadage surface than the Standard design, while still maintaining heavy sections. The Multi-fin Type is the most popular design, giving a maximum leakage distance; while somewhat more susceptible to chipping, its well-rounded corners have greatly reduced the probability of such damage.

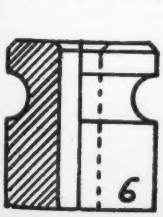


WET PROCESS STANDARD TYPE **WET PROCESS MULTI-FIN TYPE** **WET PROCESS X TYPE**

INSULATOR NO.	No. 500	No. 502	No. 504	No. 506	No. 534	No. 536	No. 538	No. 540	No. 528	No. 529	No. 530	No. 531	No. 532	No. 533
A (Inches)	2¼	3¼	4⅛	5⅝	3½	5⅜	6⅞	7	3½	4¼	4¼	5½	6¾	6¾
B (Inches)	1½	2½	2⅞	3½	2½	3¼	3½	3¾	3¼	3⅝	3⅝	3⅛	4¾	4¾
C (Inches)	1¼	1¾	2¼	3¼	1⅝	2⅛	2¾	3¼	1⅝	1⅞	1⅞	1⅞	2	2¼
D (Inches)	5/16	1/4	7/8	1	5/8	3/4	1	1	5/8	11/16	7/8	3/4	1	3/4
E (Inches)	1 1/16	1 1/2	1 7/8	2¼	1½	2	2¼	2¾	1⅝	1⅞	1⅞	1¾	3⅜	3⅜
F (Inches)	1/4	11/32	5/16	1/2	1/2	5/8	3/4	9/16	3/8	5/16	5/16	3/8	1/2	1/2
Ultimate Strength, Pounds	4,000	10,000	15,000	20,000	10,000	20,000	22,000	25,000	10,000	16,000	16,000	16,000	20,000	20,000

STANDARD DRY PROCESS PORCELAIN

SPLIT KNOBS: Glazed and unglazed; Bull Dog, 2-Groove Swivel-Cap and V-Groove Types; assembled on nails or screws; 1¾″ to 2⅛″ high; 1⅛″ or 2″ diam.; ¼″ to ⅜″ hole; ¼″, 5/16″ to 5/16″ and ¼″ to ⅜″ grooves. Packed 700 to 3000 per bbl.



KNOBS: Every commercial size and shape of knob, Nos. 0 to 56. Sizes range from ¾″ high x ⅞″ diam., ¼″ hole size and ⅜″ groove size for No. 7 Knob, up to 3¾″ high x 5½″ diam., 1″ hole size and 2½″ groove size for No. 56.

These safe, economical, efficient, and easy to install ILLINOIS insulating wiring systems of porcelain will help you to increase your installation business and build profits. This system is available for commercial, industrial, residential, and farm wiring and insures permanency and utmost safety. Use this system where dampness and fire hazards are prevalent such as in warehouses, cold storage and package plants, dairies, chemical works, ice plants, breweries, etc. Grounding is unnecessary when you use this system. Clamps are not required for porcelain boxes. No rusting or corrosion troubles.

WIRE CLEATS: 2-Way and 3-Way Standard Cleats, ⅛″ to ¼″ and ¼″ to ⅜″ groove sizes. **Standard 1-Wire Cleats,** various styles—low base and low cap; low cap and 1″ high base, and cap and base each 1″ high; 14-8 up to 1500-2000 MCM wire sizes. B. & D. 1-Wire Cleats, same styles as Standard 1-Wire; 14-10 up to 2000-3000 MCM.

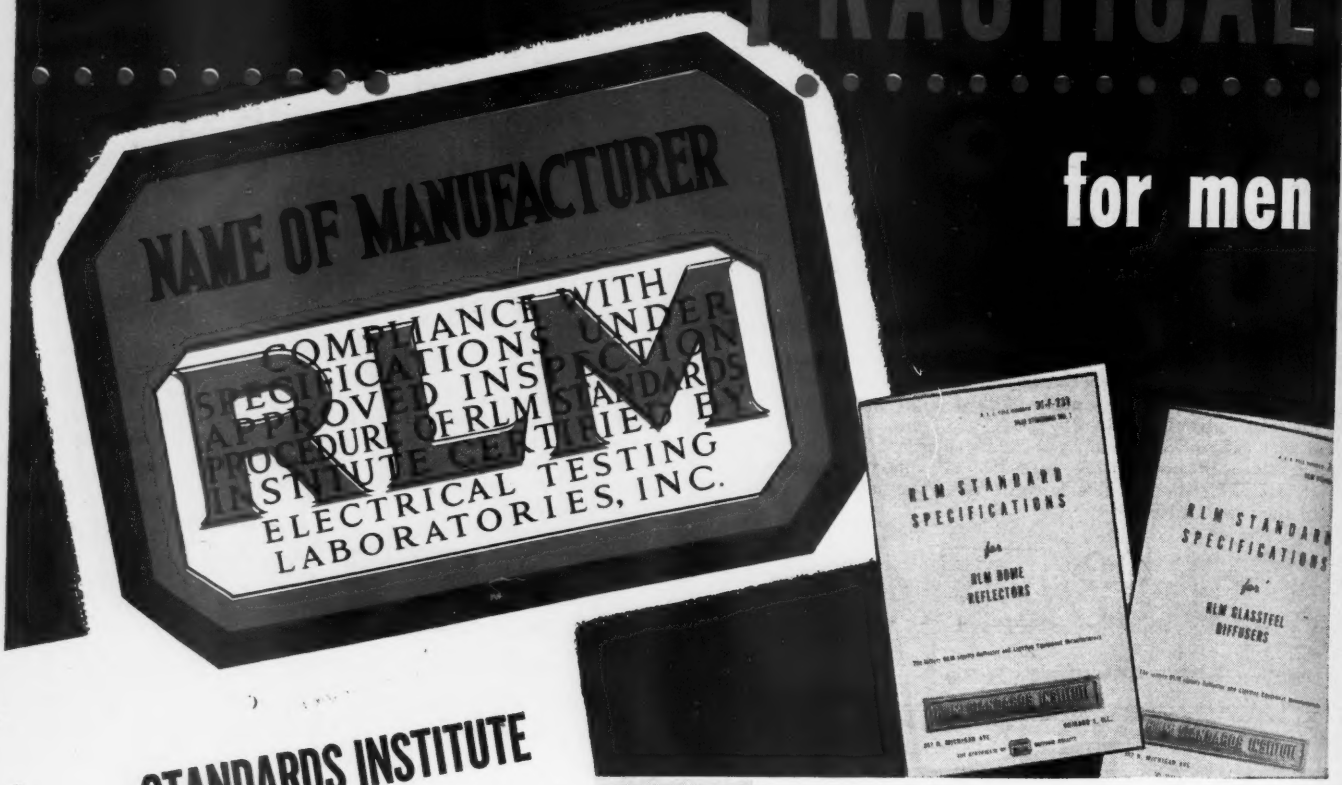
STANDARD UNGLAZED TUBES: ½″ to 48″ long under head; 5/16″ to 3″ hole sizes; 9/16″ to 4½″ O.D.

ILLINOIS ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

PRACTICAL

for men



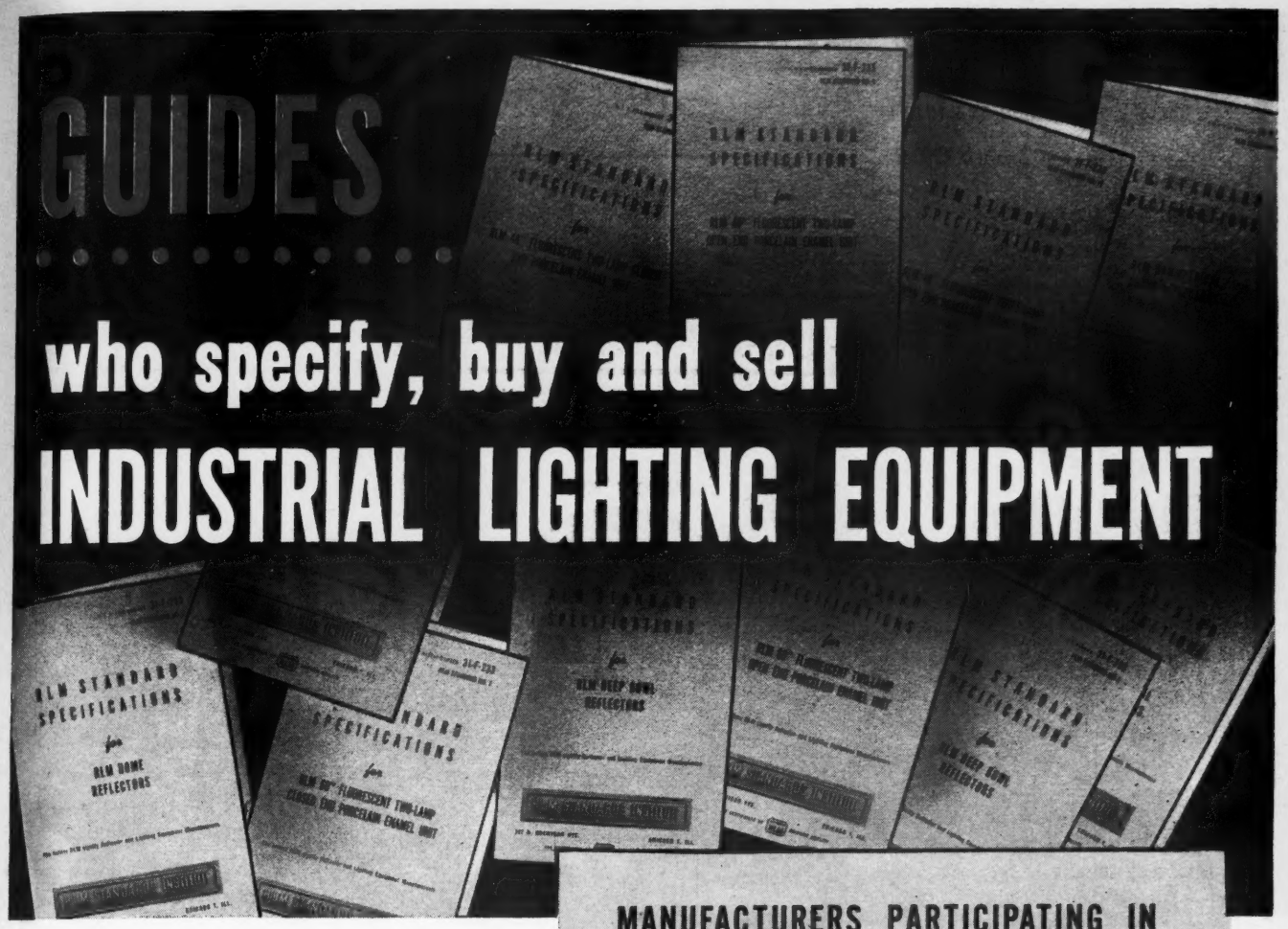
STANDARDS INSTITUTE SPECIFICATIONS

No. 100—Testing and Inspection Procedure
No. 1 RLM—Dome Reflectors
No. 2 RLM—Deep Bowl Reflectors
No. 3 RLM—Symmetrical Angle Reflectors
No. 5 RLM—48" Fluorescent Two-lamp Closed end porcelain enamel unit
No. 6 RLM—48" Fluorescent Three-lamp Closed end porcelain enamel unit
No. 7 RLM—60" Fluorescent Two-lamp Closed end porcelain enamel unit
No. 9 RLM—48" Fluorescent Two-lamp open end porcelain enamel unit
No. 10 RLM—48" Fluorescent Three-lamp open end porcelain enamel unit
No. 11 RLM—60" Fluorescent Two-lamp open end porcelain enamel unit
No. 18 RLM—Glassteel Diffusers
No. 22 RLM—48" Fluorescent Two-lampClosed End Porcelain Enamel Unit with Longitudinal Louver.
No. 23 RLM—48" Fluorescent Two-lamp Open End Porcelain Enamel Unit with Longitudinal Louver

When making plans for industrial lighting to take advantage of the latest developments in illuminating engineering, play safe by specifying industrial lighting units built to conform to up-to-the-minute RLM specifications and identified by the RLM label.

RLM Specifications are drafted by a Technical Committee guided by the findings of the *Illuminating Engineering Society,* the recommendations of the *Better Light-Better Sight-Bureau,* and other recognized industry associations.

Every industrial lighting unit qualified to bear the RLM LABEL must conform to these rigid RLM Official Standard Specifications . . . which cover construction and



performance factors vital to safety, lighting efficiency and economy.

That is why it is so worthwhile to follow RLM Specifications, and to look for this RLM LABEL when specifying, buying or selling Incandescent and Fluorescent industrial lighting equipment.

Copies of all the latest RLM Specifications, (listed at left), may be secured through any manufacturer using RLM inspection and certification service, or direct from RLM Standards Institute.

MANUFACTURERS PARTICIPATING IN CERTIFICATION PROGRAM

INCANDESCENT AND FLUORESCENT

Benjamin Electric Mfg. Company
Bright Light Reflector Co., Inc.
The Miller Company
Smoot-Holman Company
Wheeler Reflector Company
Westinghouse Electric Co.

INCANDESCENT ONLY

Goodrich Electric Company
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Jones Metal Products Company

FLUORESCENT ONLY

Day Brite Lighting, Inc.
Mitchell Manufacturing Company

RLM STANDARDS INSTITUTE
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307 N. Michigan Avenue, Suite 420 Chicago 1, Illinois

KILLARK ELECTRIC MANUFACTURING CO.

CONDUIT FITTINGS

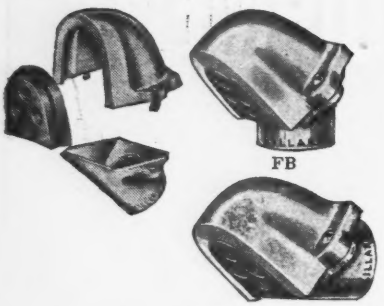
Established 1913 — *Main Office and Factory:* **VANDEVENTER & EASTON AVES. ST. LOUIS 13, MO.**

Branch Offices:

1903 Griffin St. Dallas 2, Texas
117 North 5th St. Philadelphia 6, Penna.
49 Central Ave. Cincinnati 2, O.
156 Purchase St. Boston 10, Mass.
309 Garfield Bldg. 4612 Woodward Ave. Detroit 1, Mich.
1900 Euclid Ave. Cleveland 15, O.
200 S. Peoria St. Chicago 7, Ill.
405 S. Townsend St. Syracuse, N. Y.
198 Walton St. N.W. Atlanta 3, Ga.
216 Burnet Ave. Syracuse, N. Y.
401 Marine Nat. Bank Bldg. Baltimore 2, Md.
2411 First Ave. Seattle 1, Wash.
202 Lumber Exchange Minneapolis 1, Minn.
4501 Maryland Ave. St. Louis 8, Mo.
334 E. 4th St. Los Angeles 13, Calif.
2107 Grand Ave. 501 Candler Bldg. Kansas City 8, Mo.
30 Irving Place New York 3, N. Y.
1944 Broadway Denver 2, Colo.
298 Duquesne Way Pittsburgh 22, Penna.

THE CONTENTS OF THIS PACKAGE BEAR THE LABEL OF Underwriters' Laboratories — UL

SERVICE ENTRANCE FITTINGS

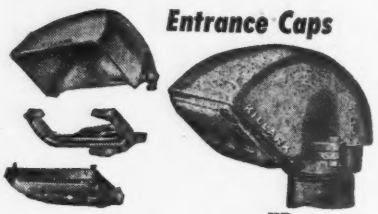


FB

NFB YFB

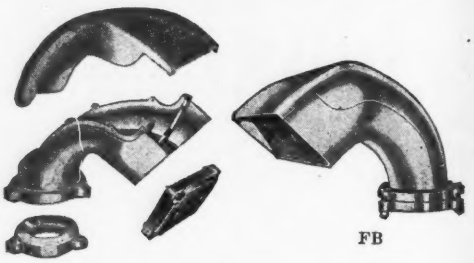
Weatherproof Entrance Cap, cadmium plated, with reversible hub section to fit vertical or horizontal conduit: composition insulator for 2, 3, or 4 wires. (Furnished for threaded or threadless rigid conduit, or thinwall conduit of ½" to 2" sizes.)

Entrance Caps



FB

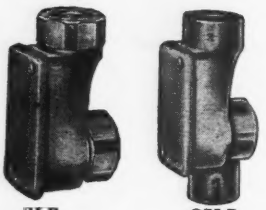
Weatherproof, for vertical or horizontal conduit — Completely waterproof—Composition insulator for two or more wires. (For threaded rigid conduit of 2½" to 4" sizes.)



FB

Weatherproof, for vertical rigid conduit from 4½" to 6" sizes. For any number of wires.

Entrance Elbows



SLB GSLB

SLB Weatherproof entrance elbows with rubber gasketed, flanged covers. For threaded conduit ½" to 3" sizes. GSLB for ¾" to 1¼" conduit with ½" or ¾" grounding hub.

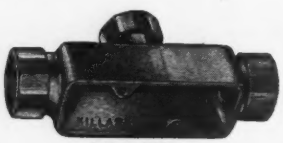
For threadless conduit, NSLB for ½" to 2" heavy wall conduit: YSLB for ½" to 2" thinwall conduit.

NSLB

CONDUIT BODIES AND COVERS

Series "L" Electrolets

For threaded rigid conduit of ½" to 6". Takes Killark covers and receptacles. All hub arrangements. Blank covers furnished with 4", 5" and 6" conduit sizes.



NTB YTB

For threadless, rigid and thinwall conduit. All hub arrangements. For ½" to 2" conduit size.

TB

Plug receptacle cover for Killark "L" type Electrolets.

APR

A popular composition cover with 5 knockouts. One of the complete Killark line of composition, porcelain and metal covers for Series "L" Electrolets.

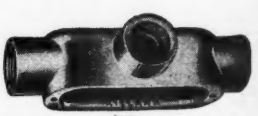
Type L

Killark blank stamped steel covers can be furnished for all size Series "L" electrolets.

Blank Metal Cover

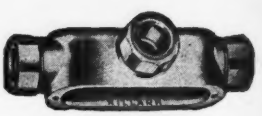
Series "O" Electrolets

For threaded rigid conduit. These are flat-back oval-type bodies with all hub arrangements. ½" to 4" conduit sizes.



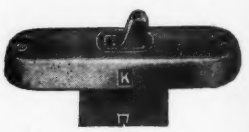
OT

For threadless rigid conduit or thinwall conduit. All hub combinations. ½" to 2" conduit sizes.



NOT YOT

Killark Series "O" switch covers are available in weathertight or non-weather-tight styles.

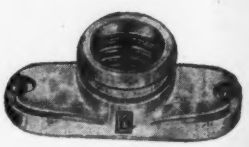


OSS

Composition receptacle covers, with single or double plugs, blank covers, etc., for Series "O" Electrolets.

OOR

Porcelain receptacles can be furnished for "O" Series Electrolets in sizes ½", ¾" and 1".



OPR

FLUSH SWITCH FITTINGS

Killark Flush Fittings are available in one- to five-gang types for threaded and threadless rigid conduit or thinwall conduit. "FS" have standard depth; "FD" are extra deep.

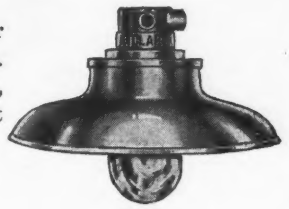
Complete line of weather-tight and non-weather-tight styles, for switches, receptacles, and pilot lights. In single gang, multiples and combinations.

FSST

FS

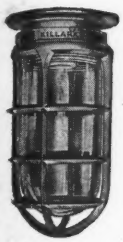
VAPOR-TIGHT LIGHT FIXTURES

Assembled type, with clear globe and screw-type guard. Furnished in pendant style, ceiling style and wall bracket style.



VUL

Assembled Type Shallow Reflector



VOBG

One-Piece Type with Guard

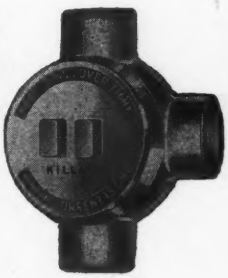
One-piece type with gasketed splice box. Furnished with shallow bowl, standard dome or angle reflector, green outside, white inside—with or without cast metal guard.

EXPLOSION-PROOF FITTINGS

"GEM" Series is one of the many round and rectangular junction boxes available in 2½" to 5½" diameters or widths. Threaded and union hubs, ½" to 2".

Sealing fittings that make possible explosion-proof conduit runs in compliance with N.E. Code. Made for ½" to 2½" conduit.

EY



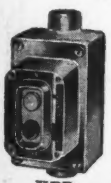
GEMT

Explosion Proof Junction Boxes.

JLT JALT

Rectangular junction boxes, with or without lugs, and with ½" to ¾" hanger stem covers or with blank covers. ½" to 1" hub sizes in all combinations.

Explosion Proof Switch Fittings



XPB

Single and two-gang fittings for enclosed toggle, push button, momentary and thermal overload switches. Made with or without mounting lugs. ½" and ¾" threaded hubs.

Explosion Proof Lights

In pendant, ceiling and bracket types with shallow, deep or angle reflectors of vitreous enamel. Heavy globe and cast guard. ½" and ¾" threaded hubs.

ELXG

FITTINGS FOR RURAL ELECTRIFICATION

Cable Service Head

With one-hole mounting bracket for quick and easy attachment to the building. Arranged for armored or unarmored service entrance cable. The cable is held rigidly in the fitting by an internal clamp.

CFBS

FKB

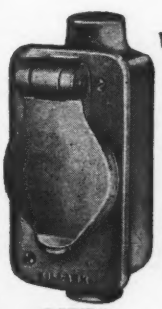
Flanged Entrance Cap

Complete with hot-dipped galvanized wood screws and a sealing compound which prevents water from seeping into the building. The insulator has four holes, two of which are knockouts. The hub in the back is extra long to reach through boards and is tapped for ½" conduit.

Sill Plates

Furnished complete with galvanized wood screws and a weatherproof compound. Provides a metallic protection for service entrance cable at the point where the cable enters the building.

SP



FSWRC

Weatherproof Receptacle

Switch Housing

Outdoor Weatherproof Switch Housing. Heavy cast box and cast cover with "on" and "off" switch arm. A standard toggle switch is used inside. Furnished in all hub combinations.

FSWTE

VOLG

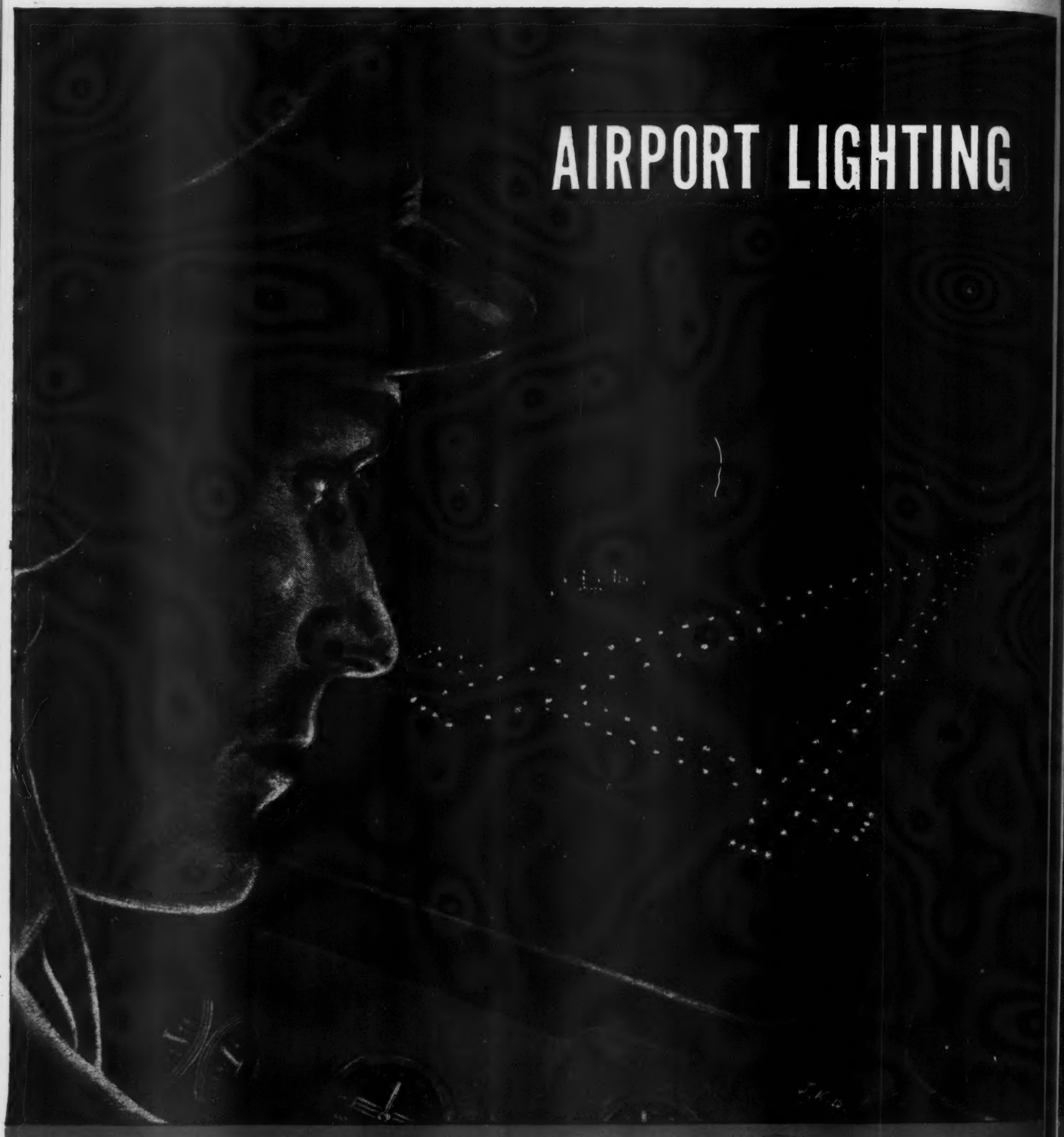
Weatherproof Wall Light

For use with or without outlet box. Furnished complete with globe and guard, or with globe only.

Weatherproof Yard Light

FYL

A weatherproof light. It consists of a cast metal fitting holding a receptacle and a twelve-inch vitreous enamel reflector. The conduit is half-inch size, sixteen inches long, and is attached to the building by an iron flange.



PACEMAKER IN WIRE PRODUCTS

WEATHERPROOF WIRE • SERVICE ENTRANCE CABLES
RUBBER AND PLASTIC COVERED WIRES AND CABLES (INCLUDING SMALL DIAMETER INSULATED BUILDING WIRES)
RUBBER SHEATHED PORTABLE CABLES • RUBBER INSULATED POWER CABLES • MAGNET WIRE • TELEPHONE WIRES
PIGTAIL AND BRAIDED COPPER • BARE COPPER STRAND
TROLLEY WIRE • VARNISHED CAMBRIC POWER CABLES

ROE
ELECTRICAL

must not fail!

IT'S AN UNDERGROUND JOB FOR ROEBLING PARKWAY CABLE

IN THE BLACK OF NIGHT, pilots must depend on the airport's electrical guides to bring them in . . . safely. Now, with runways being lengthened, new airports planned, these guides will multiply. Providing unfailing transmission of power for such vital lighting purposes is another job for Roebling rubber insulated Parkway Cable.

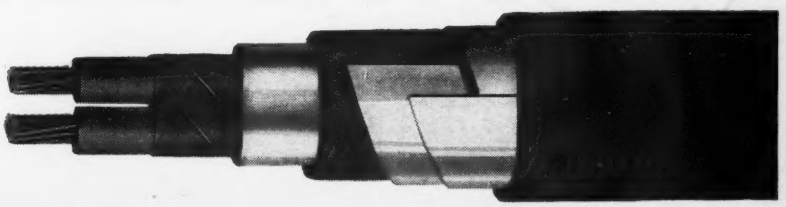
It's Dependable—to assure the steady, uninterrupted service that's a "must" for safety.

It's Underground—safely buried to eliminate the hazards of pole interference and exposure to weather.

It's Low in Installation Cost—because no expensive duct systems are needed. Easily, quickly, it can be laid directly in a shallow trench or "plowed" in.

A complete range of types and sizes is available—in metallic or non-metallic coverings, single or multiple conductors. And a Roebling engineer is *always* available to help you make the selection that's *right* for *your* service conditions . . . to help you get dependability at low cost. Our nearest branch office will gladly supply details.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

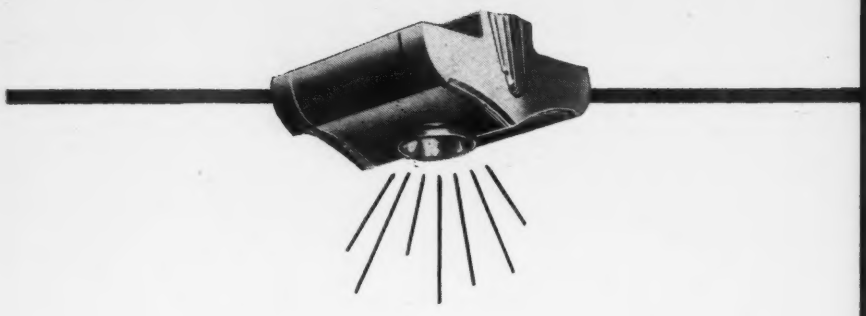


Roebling Metallic Parkway Cable, 2 conductor, with flat steel tape armor protecting the lead sheath against crushing or puncture.

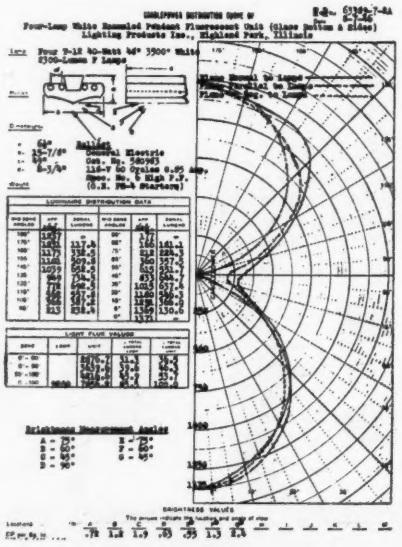
BLING

JR ROEBLING

WIRES AND CABLES

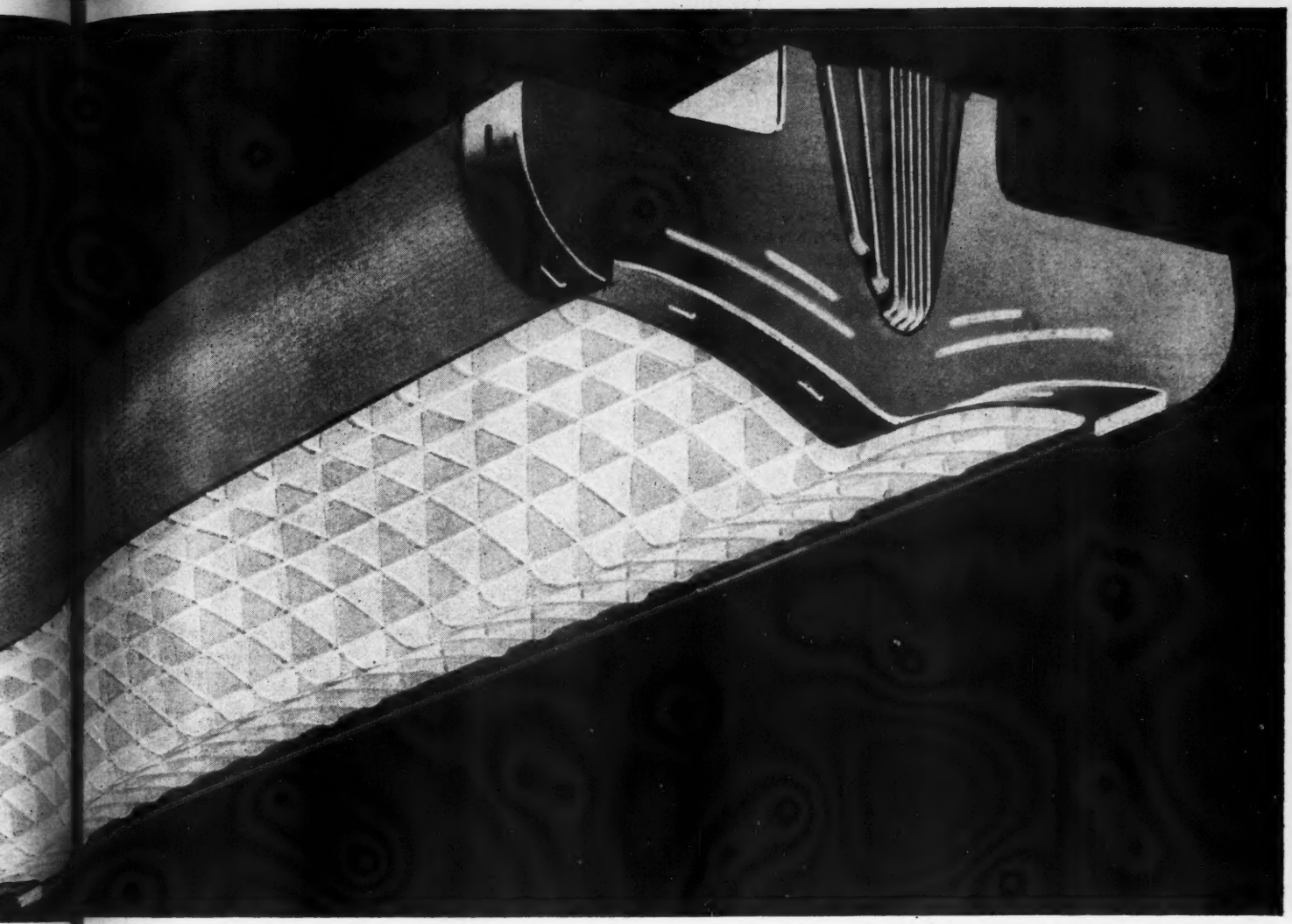


Constellation



All glass No. 110 Series approved by the Utilities Research Commission.

Above charts compiled by the Utilities Research Laboratories.



☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Where outstanding beauty, maximum lighting efficiency and extreme ease of installation and service are all required features, you will find that the new Constellation will more than fill your customers' most rigid specifications—your highest expectations.

Delivering an unusual high percentage of light to the working plane, the Constellation adds to visual comfort by diffusing the light through either all glass or combination of glass and louvers, with minimum light loss. (Note chart at left)

The Constellation is furnished for either individual, end to end pendent or surface mounting and may be installed with Lighting Products Spot-O-Lite at ends or between fixtures.

Furnished in either two or four 40 watt units, glass or louvered bottoms, the Series 110-Constellation is ideal for the more particular commercial and institutional installations—the finest that you can buy.

Write for additional information today

LIGHTING PRODUCTS, INCORPORATED

HIGHLAND PARK **ILLINOIS**

Automatic Switch Light Proves Popular Seller

Popularity of the automatic switch light known as "LumiNite," manufactured by Associated Projects Company, of Columbus, Ohio, is attributed by the makers to such special features as its listing by the Underwriters Laboratories, its unconditional renewal guarantee, sealed-in light mechanism, streamlined one-piece design, and beautifully matched units for all multi-gang switch assemblies.

The LumiNite switch light, which merely replaces the conventional switch plate, features a tiny shielded light that comes on automatically when room lights are turned out, and remains off whenever room lights are burning. Thus it not only makes the switch easy to locate in the dark but also serves as a safety or pilot light at night, and helps keep walls free of smudges from hands groping for light controls.

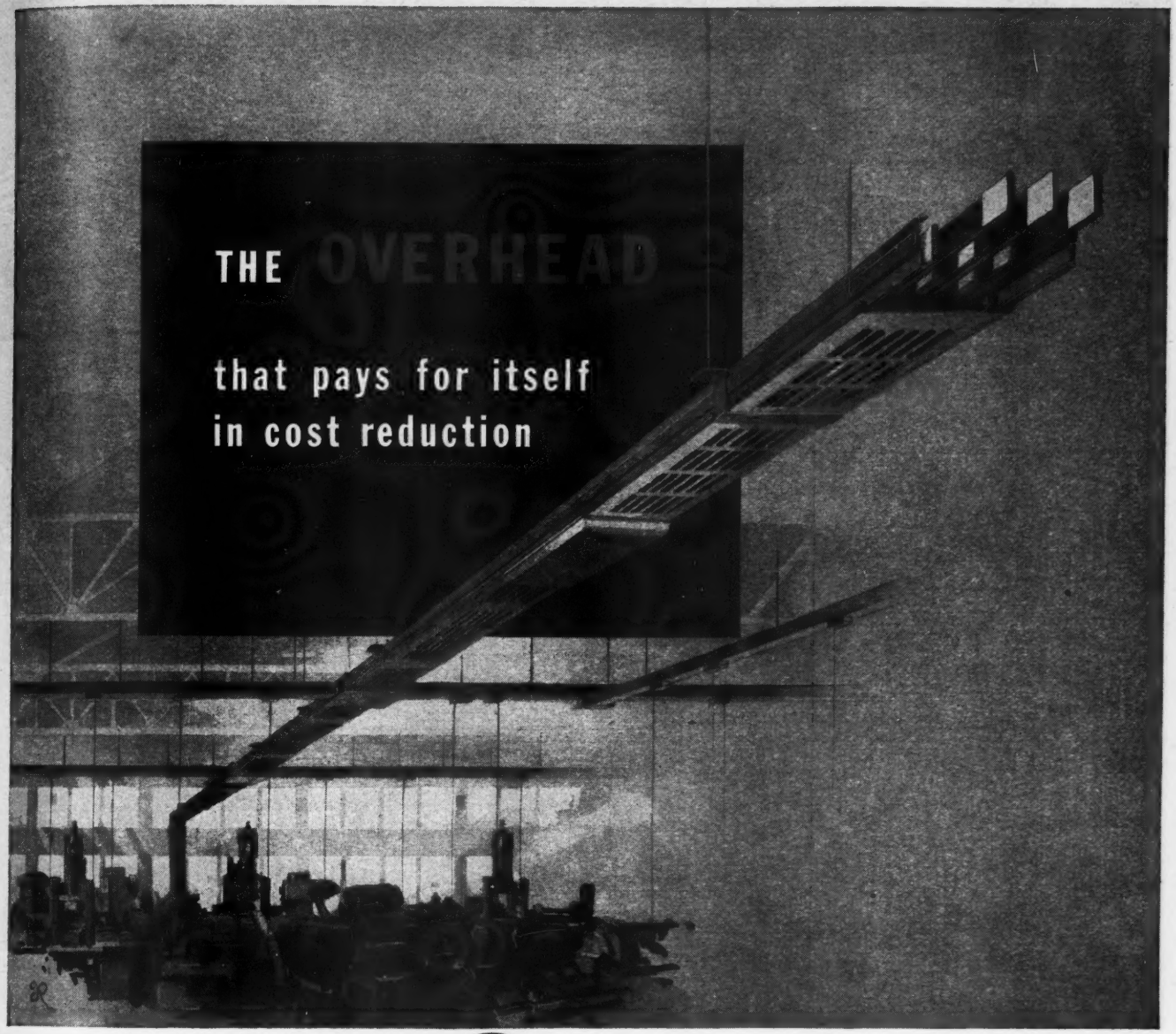
Another selling point of the LumiNite is that *it saves on light bills by indicating whenever porch or other lights that can't be seen from the switch location have been inadvertently left on.*

The plate is molded in a single piece of ivory plastic, at the top of which is an attractive housing for the glow lamp and mechanism.

The bulb used is said to operate at the surprisingly low cost of one or two cents per year for current. And because it minimizes the heat factor which shortens the life of ordinary light bulbs, extremely long service life is a major LumiNite feature.

The unit fits any standard toggle switch, and works equally well in three- and four-way switch arrangements. Installation is quickly accomplished by simply connecting two wires to the terminals on the switch.

LumiNite products are distributed through all regular wholesale and retail channels and are available for prompt delivery. Full information may be obtained quickly by writing to the Associated Projects Company, 80 East Long Street, Columbus 15, Ohio.



TRUMBULL (T) ELECTRIC

FEEDER DISTRIBUTION SYSTEMS

In exactly the same way that accidents, road blocks and costly maintenance plague the highway department when a road system is inadequate—so do plant managers pay for inadequate electrical power distribution.

Machines cannot efficiently operate at less than their rated voltage—overloaded lines in your plant mean costly patching of your distribution system—MONEY OUT OF YOUR POCKET.

Your inadequate distribution system is no doubt making you pay now for a full-powered, low-cost Trumbull Feeder Distribution System.

Trumbull Buss-Wa Systems (main feeders) Flex-A-Power (branch feeders) and Control Centers (motor control distribution) are available to you NOW.

Write directly to Trumbull Electric Mfg. Co., Plainville, Conn., for further information.

Available now FROM FACTORY STOCK

THE TRUMBULL ELECTRIC MANUFACTURING CO. • PLAINVILLE, CONN.

Other Factories at NORWOOD, OHIO • LOS ANGELES • SAN FRANCISCO • SEATTLE


SPERO offers 5 Lines o
Dependable Electrical Product
Comprising 155* separate item
The large and complete Spero Line greatly simplifies the supply of elec
lighting fixtures and construction equipment by making it possible to
one dependable source for nearly all requirements. Spero's 5 lines inclu
more than 60 types and sizes of reflectors
10 types and sizes of floodlights
28 types and sizes of vapor-proof units
more than 30 types and sizes of fluorescent fixtures*
20 types of switchplates
7 types of insulators
more than 15 other items used in electrical construction
This adds up to 155* profitable items for you and your custom
The modern spacious Spero plant is equipped with the latest assem
line production machinery, making it possible to offer prompt delive
quality products, priced right to meet competition.
*"MSB" glass-enclosed fluorescent units will soon increase this tot
and your sales volume.

—giving you 155 good reasons for specifying Spero

By actual count, the Spero lines total 155 different types and sizes of products tailored to fit into your specifications. All of their products are made in one plant, and are the result of 30 years' experience in satisfying contractors' needs . . . Your electrical wholesaler stocks these quality lines. The next time specify Spero.

You can depend on Spero to furnish products of quality standards that build customer satisfaction and good will. No need to take chances on uncertain, "or equivalent" specifications. Spero products are tested, approved, and meet U. L. requirements.

Spero lighting fixtures are designed for quick and easy installation and maintenance. Lamps, tubes and other parts requiring cleaning or changing are easily accessible and removable.

Spero production schedules are fast approaching normal, and delivery of most items is being made promptly from stock or current production. If you are not familiar with all 5 lines of Spero products, write today for Bulletin No. 10.

Since its founding, 30 years ago, Spero has held strictly to its announced policy of *"Distribution only through legitimate electrical wholesalers"*. Besides protecting jobbers handling Spero lines, this policy makes it possible at all times for contractors and dealers to obtain Spero Products through their regular channels.

THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

SPERO offers 5 Lines of Dependable Electrical Products Comprising 155* separate items

The large and complete Spero Line greatly simplifies the supply of electric lighting fixtures and construction equipment by making it possible to use one dependable source for nearly all requirements. Spero's 5 lines include:

- more than 60 types and sizes of reflectors
- 10 types and sizes of floodlights
- 28 types and sizes of vapor-proof units
- more than 30 types and sizes of fluorescent fixtures*
- 20 types of switchplates
- 7 types of insulators
- more than 15 other items used in electrical construction
- This adds up to 155* profitable items for you and your customers

The modern spacious Spero plant is equipped with the latest assembly line production machinery, making it possible to offer prompt delivery of quality products, priced right to meet competition.

*"MSB" glass-enclosed fluorescent units will soon increase this total—and your sales volume.

—giving you 155 good reasons for specifying Spero

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THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

Specify **PORCELAIN**

PORCELAIN
PROTECTED WIRING
SYSTEMS

THE OLDEST SYSTEM OF WIRING AND

As Modern as Today . . .

N to get ADEQUACY . . . . SAFETY · PERMANENCY · FLEXIBILITY · ECONOMY ·

AMERICA'S NEW BUILDING PROGRAM . . .

Whether it is the City Home, the Suburban Home, the Industrial Worker's Home, the Farm Home, the Summer Home, Garages, Warehouses, Stores, industrial and institutional buildings, PORCELAIN insures complete insulation and protection from the entrance switch to the last outlet on the system.

Quick installations are accomplished — economical results are realized—short-proof and shock-proof qualities of porcelain contribute to dependability — rust and corrosion resistance characteristics make porcelain the ideal material in damp, wet, or dry locations — meets future load increase — allows for easily made alterations and additions.

Specify PORCELAIN

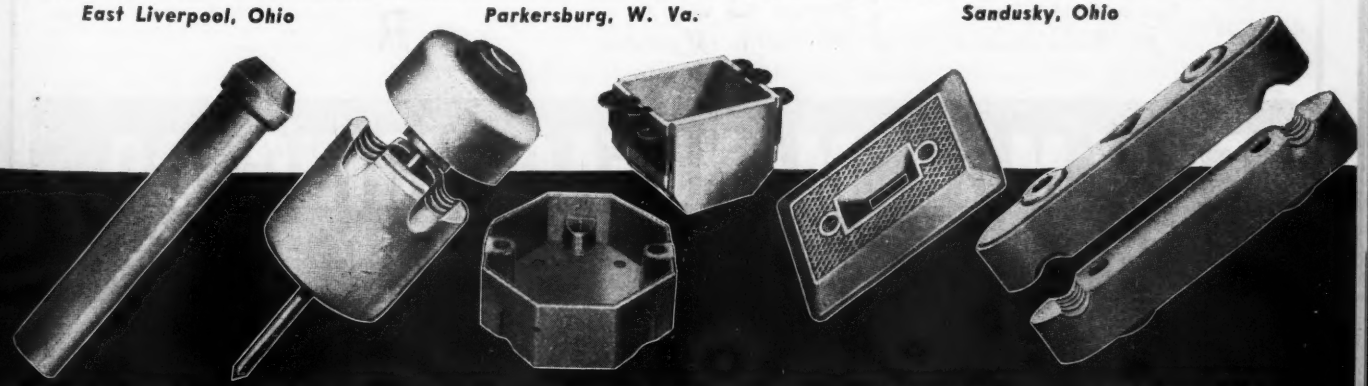
★ **ILLINOIS ELECTRIC PORCELAIN CO.**
Macomb, Ill.

★ **PORCELAIN PRODUCTS, INCORPORATED**
Findlay, Ohio

★ **SPECIALTY PORCELAIN WORKS**
East Liverpool, Ohio

★ **SUPERIOR PORCELAIN COMPANY**
Parkersburg, W. Va.

★ **UNIVERSAL CLAY PRODUCTS COMPANY**
Sandusky, Ohio



MODERN PORCELAIN PROTECTED WIRING SYSTEMS

FULLMAN *Electrical* PRODUCTS

MAKE UNDERFLOOR OUTLETS *CONVENIENT—PRACTICAL*

The "How To" of solving "Floor Outlet Bottlenecks" for the life of every building is a simple procedure with "Latrobe" Adjustable Watertight Floor Boxes. No electrical plan is adequate or complete without a liberal "spotting" of floor receptacle outlets. No long cords or dangerous "floor extensions" are needed when Latrobe Floor Boxes are indicated at close spacings in all floor areas where any possible future lighting, power or low tension need may exist.

Fullman floor boxes are made in single or gang combinations, for receptacles, for telephone service or other signals. Sketches below indicate how easy it is to install the correct type from among the wide selection of Latrobe floor boxes made for conduit and thin wall underfloor installations, also for cable wiring where boxes are used in wood frame floor construction. Latrobe floor boxes meet every need in new work or remodeling. They solve "Outlet Bottlenecks" wherever there are "Wide Open Spaces".

Architects, Engineers, Contractors and Wholesalers—consult your Fullman Manufacturing Co. representative on the "How To" story to fit every electrical plan and specification.

No. 110 Watertight Box

The No. 110 Box is a neat appearing unit of simple construction. The No. 208 Receptacle shown, contains few parts and is designed for rapid, easy installation. The wireman simply attaches wires to the Receptacle, fastens on the Cover Plate and Receptacle is ready for use. No. 100—Used as a telephone outlet or junction box. Consists of iron box body, 3½ inch round brass cover plate and No. 206 Stem Nozzle. Furnished without stem nozzle if desired. Height 3-1/8 in. from bottom of box to top of cover plate.

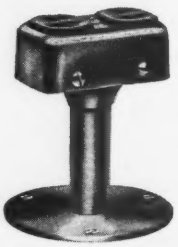
No. 130 Floor Box With No. 207 Bell Nozzle

The "Latrobe" No. 130 Adjustable Watertight Floor Box is furnished complete with No. 208 Receptacle which is tapered to fit tapered opening in boxtop. Adjustable top with Brass Edge Ring insures cover plate being flush with finished floor in fireproof construction. Cover plates are 3½" in diameter.

No. 252-R Floor Box With Nos. 206 and 207 Nozzles

The 2-gang adjustable Floor Box is shown with No. 208 Receptacle in one section. One Cover Plate has ½" Flush Brass Plug and one has 2" Flush Brass Plug.

Latrobe Gang Box Bodies are provided with solid partitions to separate high and low tension wires. Two, three and four Gang Boxes are drilled and tapered standard with ¾" conduit holes in sides and ends.



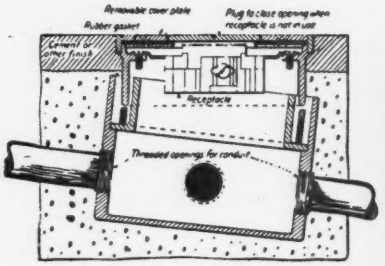
No. 284 Nozzle With No. 200 Cover Plate

Here we have the neatest and most compact Duplex Receptace Nozzle on the market. Shown with ½" Brass Pipe Extension. Can be furnished also with ¾" pipe extension.

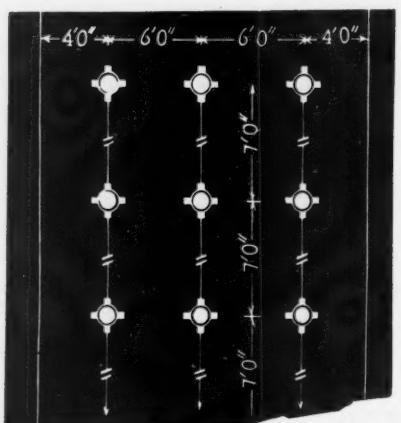
Latrobe Nozzles are made in all types for use with "Latrobe" Watertight Floor Outlets including 30 amp. 2 and 3 wire Receptacle Nozzle, Duplex Telephone Nozzles, Bell and Stem Nozzles of various sizes and types.

"LATROBE" UTILITY OUTLET

For use in wood floors, mantels, baseboards, show windows, and other installations free from moisture or mechanical injury. Can be quickly installed without marring the finish of the woodwork. It is only 2½" in diameter and 2" high and is fitted with 10 amp. 115 volt Bakelite receptacle.



Easy to install and align with all types of finished floors. Readily accessible and never in the way when not needed.



Indicate "Latrobe" Floor Boxes at close spacings to solve "Outlet Bottlenecks" for the life of the building.

WE ALSO MANUFACTURE

Insulator Supports	Armored Cable Supports
Conduit Benders	B X Cable Staples
Pipe or Conduit Hangers	Keystone Fish Wire

Warehouse stocks in eleven cities—write for catalog.

FULLMAN MANUFACTURING CO.

LATROBE . . . . . PENNSYLVANIA

Popular? **You bet! Why? Because Security is straight-tearing... non-ravelling...highly dielectric...has great tensile strength. Its strong rubbery adhesive *sticks* and *holds*.**

SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

1230 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

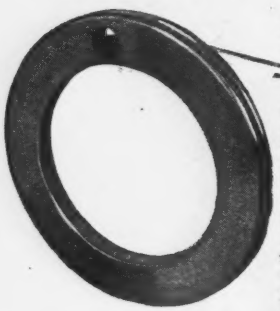
IDEAL

HOUSE WIRING SPECIALS

"WIRE-NUTS"

For hundreds of various house and other wiring jobs, IDEAL wire connectors provide the modern way to make quick, safe, easy and lasting joints. They are easy to use—you simply (1) strip wires, (2) screw on — that's all! And, you have a wire joint that's better electrically, stronger mechanically. They eliminate the fuss and bother of old fashioned solder-and-tape and blow-torch methods. All you need is a wire stripper and a pocketful of "Wire-Nuts." Made in five sizes for all solid and stranded wire combinations from 2 No. 18 to 3 No. 10. FULLY APPROVED. Millions in use!

FISH TAPE, REEL AND PULLER



No more worry about Fish Tape getting loose and springing all over the floor. With the IDEAL Fish Tape Reel, it is easy to pull tape through conduit quickly. While the coil of steel tape is held securely in the reel at all times, it can be instantly and quickly run out to any length, with constant tension on the wire being maintained—no kinks, bends or breaks.

The Fish Tape, Reel and Puller is three tools in one; belongs in every Electrician's Kit along with pliers, cutters and screw driver. Made in 8 convenient sizes.

B-X ARMOR CUTTER

B-X cable (either two or three wire, No. 12 or No 14) is easily and quickly cut in one snip with this handy new pocket size tool. The B-X Armor Cutter eliminates antiquated, dangerous hack saw methods. This tool cuts cleanly, without injury to insulation. Has a special steel cutting blade removable for sharpening.

SERVICE ENTRANCE CONNECTORS

Especially efficient for making connections between service drop conductors and house entrance leads. The body is made of cold drawn copper; the screws of Everdur. These service entrance connectors take wire Nos. 2 to 10 stranded, and No. 12 solid. Easily applied with a screw driver or pliers.

"SCREW-TITE" SOLDERLESS LUGS

Can be quickly and securely attached with either screw driver or wrench. "Screw-Tite" Lugs require no solder —no special application tools. Made of seamless electrolytic copper, accurately pressed for uniform size. Heavy brass, checkproof shell reduces heating. Flat contact surfaces assure minimum resistance, with full carrying capacity evenly distributed from wire to lug. There is no metal cut away to reduce capacity. Made in 8 sizes for No. 14 wire to 2,000,000 CM cable (35 to 1050 amps.) Special "Screw-Tite" Lugs are available.

CABLE RIPPER

Cuts non-metallic sheathed duplex cable or lead covered cable — cleanly, quickly, easily, in one simple operation. Case hardened cutting point provides positive, clean ripping by simply squeezing cable ripper on cable and pulling. Can also be used for ripping outer sheathing of other cords, lead cables, etc., where outside diameter is not greater than ⅝". Overall length 3¾" — weight 2 ounces.

WIRE and CABLE REEL

Easily hangs anywhere — from joist, pipe beam or wherever it is handy, giving the workman complete control of coiled wire or cable. Steel frame is designed with one part of the frame smaller than the other, so that when Reel is folded it requires no more room than an ordinary coat hanger. A finger locking device holds Reel open or closed. Handles practically any type of coil from 3" to 14" inside diameter, insulated wire from No. 18 to No. 2, electrical cord, rope, armored cable, romex, binding, etc.

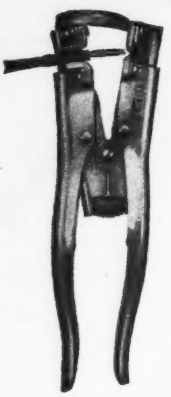
SPLIT BOLT CONNECTORS

These new IDEAL Split Bolt Connectors are made of either high quality bronze, brass or aluminum. They have precision contact surfaces, to produce maximum conductivity. They are used for permanent or temporary solderless connections. Available in Two Types —"one piece" and "two piece" with small or large heads. On the "one piece" type a flexible link permits universal movement of the nut. The nut swings entirely clear of the slot, eliminating interference with wires during installation.

JOIST BORING MACHINE

No more climbing up and down ladders, no more back breaking, stooping or straining. This IDEAL Joist Boring Machine bores through rafters, joist or studding up to height of 11 feet or bores below floor level. Bit locks into position with a knurled collar. Weight 11 lbs. The joist borer is now available "knocked down," without pipe, to assemble on the job. Either standard ½" pipe or conduit can be used.

"E-Z" WIRE STRIPPERS



Here is a handy wire stripper. Pocket size, only 7½ inches long—weight 24 ounces. "E-Z" Wire Strippers come in 2 models. "Automatic" and "Standard."

Operating on the triple action principle, the "Automatic" model clamps the wire, cuts insulation and strips it, all in one simple operation. A lever stops the return of the arms until the wire is removed, after stripping. Strips stranded wire but can be used equally well on solid wire.

"Standard" Model does not have "return lever." It is particularly suited for stripping solid wire, but can be used for stranded wire. Five sizes strip No. 30 to 8 gauge—solid or stranded wire.

DISTRIBUTED THROUGH AMERICA'S LEADING WHOLESALERS

IDEAL INDUSTRIES, Inc.

Successor to Ideal Commutator Dresser Co.

1041 PARK AVENUE **SYCAMORE, ILLINOIS**

BERNS AIR KING

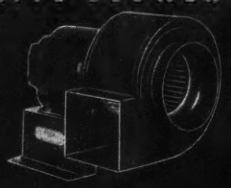
BERNS AIR KING

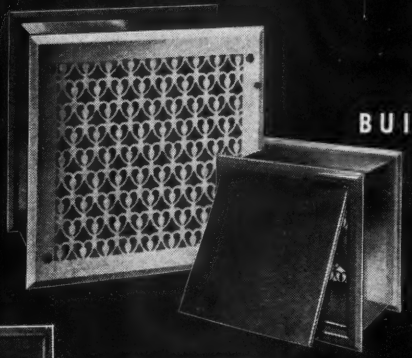
BELT DRIVEN EXHAUST FAN

Economical ventilation for commercial, industrial and attic purposes. Moves large quantities of air quietly and efficiently. Rugged, sturdy, built to last.

DIRECT DRIVE BLOWER

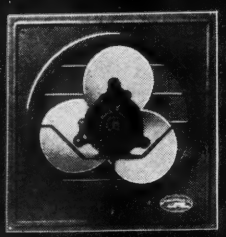
Perfect for ventilating, heating and air conditioning systems. Designed for long years of service... with husky standard make motor and heavy gauge steel construction throughout.





BUILT-IN TYPE FULLY AUTOMATIC KITCHEN VENTILATING FAN

Starts and stops with simultaneous opening and closing of outside door by merely pressing a switch! Beautiful grill in gleaming white enamel or polished chrome. Heavy duty, extra quiet motor. Adjustable to wall thickness. The perfect fan for every new home construction. At an unusually low price. Pull chain type same construction as fully automatic fan also available at unbelievably low cost.

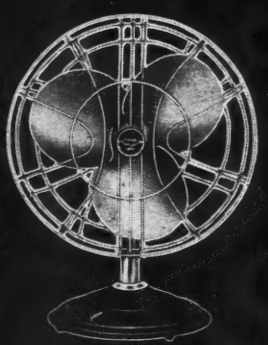


DE LUXE EXHAUST FAN
with Automatic Shutters Attached

Beautiful in appearance with tremendous sales appeal. Rugged, heavy gauge steel frame with welded joints. Heavy duty standard make motor. Every feature you could want, including a lower price.

SHORT PEDESTAL AIR CIRCULATOR

Big, dynamically balanced blades and powerful sleeve bearing motor moves large quantities of air quietly and efficiently. Smart wrinkle finish; chrome guard and trim. Fine for office, factory or store.



3 BIG ADVANTAGES

That Make This the Fastest Selling Fan Line With the Country's Leading Jobbers

1. **STYLE AND PERFORMANCE** — Attractive appearance and efficient operation eliminates sales resistance.
2. **GUARANTEED QUALITY** — All fan parts completely Berns Built and Engineered.
3. **LOWER PRICES** — Easier Sales—Higher Profits.

At last you can be sure of the quality of every fan you buy . . . in a complete line of fast selling, high profit fans for almost every purpose. From the all-steel frame to the dynamically balanced aluminum blades, quality and economy are built in at the Berns plant. Berns' complete production facilities give you lower sales-appealing prices to help you meet and beat all competition. WRITE FOR PRICES AND LITERATURE ON COMPLETE LINE AND DISTRIBUTORSHIP DETAILS.

SOLD EXCLUSIVELY THROUGH LEADING ELECTRICAL WHOLESALERS

BERNS MFG. CORPORATION, 2278 Elston Ave., CHICAGO 14, ILL.

"Certified"

ON A BALLAST COVERS A LOT OF TERRITORY!

Here are a few of the more important reasons why

To begin with, that CERTIFIED label means fluorescent lamp ballasts which have been built to rigid specifications . . . tested, checked and CERTIFIED as meeting those specifications by impartial experts—Electrical Testing Laboratories, Inc. of New York.

Specifically, the benefits to users and sellers of Certified Ballasts *cover lots of territory.* For instance: Certified Ballasts are quiet in operation. They're protected against dangerous temperature rises. Properly installed, Certified Ballasts will outlast the entire lighting installation. Rigid specifications, careful testing and latest manufacturing methods produce *uniform quality.* And Certified Ballasts *cost no more* than any other ballasts!

So why not be sure? Look for the ETL Certification mark on the equipment you specify.

Certified Ballast Manufacturers

Makers of Certified Ballasts for Fluorescent Lighting Fixtures

The Acme Electric & Mfg. Co.
Cuba, New York

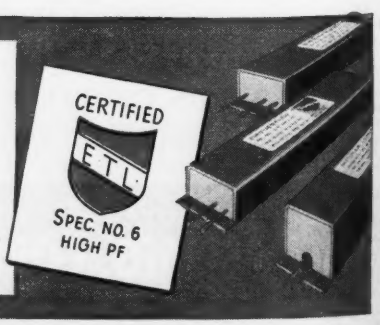
Chicago Transformer Div.
Essex Wire Corporation
3501 Addison St., Chicago, Illinois

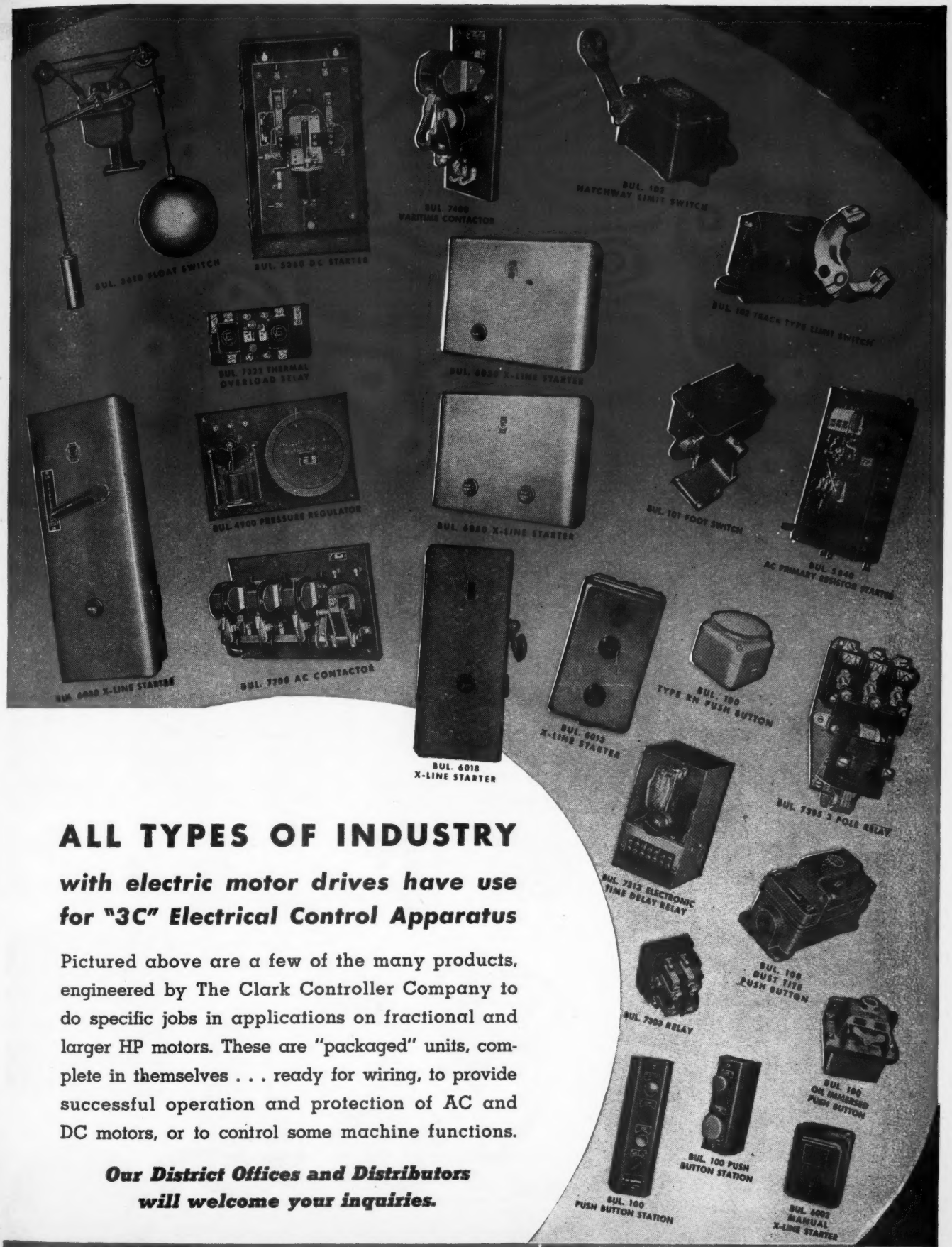
General Electric Co.
Specialty Transformer Division
Fort Wayne, Ind.

Jefferson Electric Co.
Bellwood, Illinois

Sola Electric Co.
2525 Clybourn Avenue
Chicago 14, Illinois

Wheeler Insulated Wire Co.
378 Washington Ave., Bridgeport, Conn.





ALL TYPES OF INDUSTRY

with electric motor drives have use for "3C" Electrical Control Apparatus

Pictured above are a few of the many products, engineered by The Clark Controller Company to do specific jobs in applications on fractional and larger HP motors. These are "packaged" units, complete in themselves . . . ready for wiring, to provide successful operation and protection of AC and DC motors, or to control some machine functions.

Our District Offices and Distributors will welcome your inquiries.

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • OFFICES IN PRINCIPAL CITIES

Explosion-Proof CONDULETS

The illustrations show a representative selection from the thousands of types and sizes of Explosion Proof Condulets, especially designed for use in electrical installations in locations that are hazardous because flammable atmospheres are present or likely to be present.

(CONDULETS are made only by CROUSE-HINDS)

No. 12
of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes — there is a wide variety of highly specialized types in each classification.


Type GUB Explosion-Proof Instrument Condulet


Type HRC Explosion-Proof Mercury Switch Thermostat Condulet

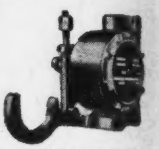

Type ETH Explosion-Proof Howler Signal Condulet


Type FLDC Explosion-Proof Secondary Breaker Condulet

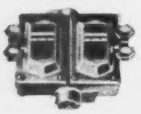

Type GUP Explosion-Proof Condulet


Type EFS Explosion-Proof Switch Condulet


Type ETH Explosion-Proof Siren Signal


Type FGCH Explosion-Proof Switch Condulet for gasoline bulk stations


Type GUAP Explosion-Proof Condulet


Type EFSC Two-Gang Explosion-Proof Push Button Switch Condulet


Adjustable Type EHS Explosion-Proof Delayed Action Receptacle Condulet with Chromium Face Plate for hospital operating rooms and similar hazardous locations


Type FSQ Explosion-Proof Interlocking Receptacle and Switch Condulet with Plug

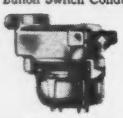

Type EVH Explosion-Proof Hand Lamp


Type RCDE-8 Explosion-Proof Floodlight 200-Watt


Type EZS Explosion-Proof Sealing Condulet for 1/2 to 3-inch conduit


Type EYS Explosion-Proof Sealing Condulet


Type CPS "T" Explosion-Proof Condulet

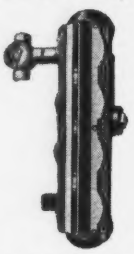

Type OFC Explosion-Proo. Push Button Station Condulet


Type GUAC Explosion-Proof Condulet


Type GUJL Explosion-Proof Condulet


Type EHS Explosion-Proof Triple Switch Condulet


Type CES Explosion-Proof Delayed Action Arktite Plug Receptacle Condulet

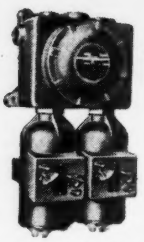

Type ELG Explosion-Proof Gauge Lighting Condulet Fluorescent


Type EMH Explosion-Proof Instrument Condulet


Type GUEL Explosion-Proof Condulet


Type EGP Explosion-Proof Push Button Station and Pilot Light Condulet for panel mounting


Type EVA Explosion-Proof Lighting Fixture 150-Watt


Type ESP Explosion-Proof Panelboard


Type EZS Explosion-Proof Sealing Condulet for 3-1/2 to 6-inch conduit

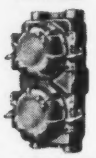

Type EHS Explosion-Proof Signal Light Condulet


Type EJH Explosion-Proof Condulet with Dome Cover

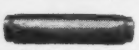

Type FLB Explosion-Proof Circuit Breaker Condulet

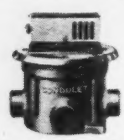

Type CPS Explosion-Proof Delayed Action Arktite Receptacle with Plug

Type EVA Explosion-Proof Sign Light Condulet


Type GUSC Two-Gang Explosion-Proof Circuit Breaker Condulet


Type ECJ Explosion-Proof Flexible Coupling


Type ESC Explosion-Proof Condulet


Type EHS Explosion-Proof Thermostat Condulet


Type LBH Explosion-Proof Condulet


Type HR Explosion-Proof Thermostat Condulet

Type CPS Two-Gang Explosion-Proof Delayed Action Arktite Receptacle

Type ELG Explosion-Proof Gauge Lighting Condulet

Type UNA Explosion-Proof Connector with Angular Adjustment

Type ETR Explosion-Proof Bell Signal

Type ECD Breather Valve

Type ECD Drain Valve

Type FSQC Explosion-Proof Interlocking Receptacle and Switch Condulet

Type EPH Pothead Explosion-Proof Condulet

EPC Series Explosion-Proof Condulets Motor Starters, Circuit Breakers and Combinations

Type RLEE-14 Explosion-Proof Floodlight 500-Watt

Type EMS Explosion-Proof Mercury Limit Switch Condulet

Type EDP Explosion-Proof Panelboard

Type EJB Explosion-Proof Condulet

Type EVG Explosion-Proof Lighting Condulet for gasoline pumps

Type RCDE-8 Explosion-Proof Portable Floodlight 200-Watt

Type EVA Explosion-Proof Lighting Fixture 500-Watt

Type EPC Explosion-Proof Interlocking Plug Receptacle and Circuit Breaker Condulet

A Nationwide Distribution Through Electrical Wholesalers

Complete listings of each type are in Condulet Catalog 2500.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y., U.S.A.

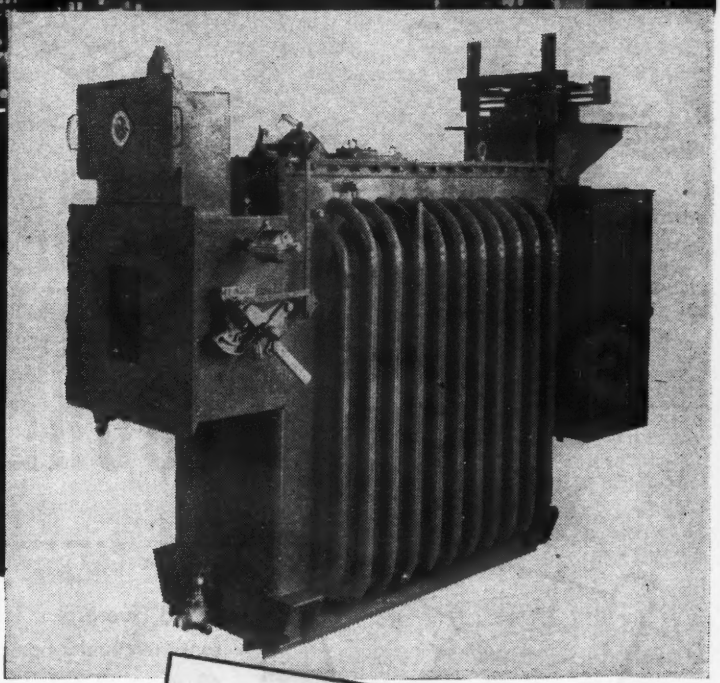
Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St Louis — Washington. *Resident Sales Engineers:* Albany — Atlanta — Charlotte — Indianapolis — New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

AMERTRAN

Abestol-Immersed

TRANSFORMERS



have a fine safety record in congested network service

AMERTRAN Abestol, the insulating coolant in these transformers, cannot burn nor liberate inflammable gases. For this reason, Abestol-immersed units are permitted by the National Electrical Code to be installed *without* vaults, either indoors or outside. In congested business and industrial areas, including some of the most intricate network layouts in the country, AmerTran Abestol Transformers have established a perfect record of safety. In most cases, also, their installation has been effected at substantial savings in cost. Since no vault construction is required, and since there are no installation restrictions, they are installed to take full advantage of shortened secondary lines and better voltage regulation —at load centers.

Install them anywhere—on platforms, on the floor with the load, in basement or on the roof. They are safe, efficient and economical, for every distribution use.

- ★ Non-inflammable
- ★ Require no vaults
- ★ Meet full requirements of National Electrical Code
- ★ Mounted anywhere—save valuable space
- ★ Eliminate necessity for long secondary lines
- ★ High electrical efficiency

AMERTRAN

REG. U. S. PAT. OFF.

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

AMERICAN TRANSFORMER CO., 178 Emmet St. Newark 5, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMER-TRAN

GUTH

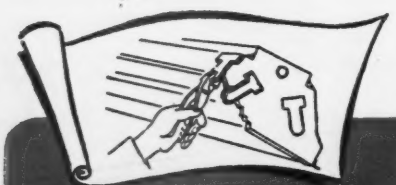
RECESSED TROFFER LIGHTING

COMBINES EFFICIENT ILLUMINATION

with MODERN ARCHITECTURAL TREATMENTS!

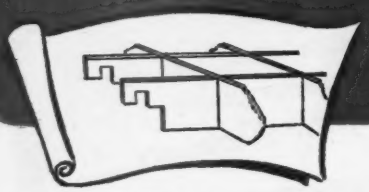
STUDY THESE CONSTRUCTION FEATURES THAT DISTINGUISH

Guth FLUORESCENT TROFFERS



ACCURATE 48.0" LENGTHS RESULT OF PATENTED K.O.'s

GUTH Troffers are simple and economical to install, fitting perfectly into ceilings of standard acoustical blocks or tiles without fitting or trimming openings. Patented K. O.'s permit lampholders to be set into ends for accurate 48.0" length.

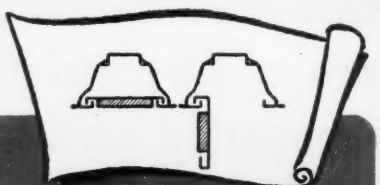


COMPLETE SELECTION OF INTERCHANGEABLE ACCESSORIES

Any GUTH Troffer accomodates Eggcrate Louvres, "Ceiling Bright" Louvres, Cross Baffles, or Glass Panels. Accessories may be added or changed at any time.

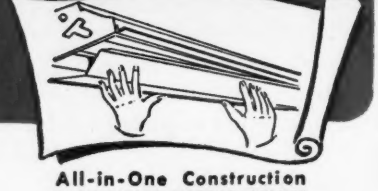
GUTH Fluorescent Troffers represent the culmination of more than 40 years of experience in good light engineering. GUTH Troffers are adaptable; suitable for use in schools, offices, stores, public buildings. GUTH Troffers are versatile; can be used with any ceiling surface singly, end-to-end, or in "patterns of light" for thrilling illumination beauty. GUTH Troffers are easy to install; built as completely assembled lighting units.

You should know more about GUTH Troffers. Write today for full details. Production restrictions limit deliveries, but GUTH Fluorescent Luminaires are worth waiting for.



EXCLUSIVE "FREE-HINGES" SIMPLIFY MAINTENANCE

The flanges in the Glass Frames fit into special "Troffer Lips" to form a convenient "Free-Hinge" —simplifying removal of glass for cleaning and relamping. Glass panels are held securely —open or closed.



All-in-One Construction SIMPLIFIES INSTALLATION

Assembly is done at the factory—not on the job! K. O.'s afford continuous wire-way, and removable reflectors give access to wiring & ballast.

Guth LEADERS IN LIGHTING Since 1902

THE EDWIN F. GUTH CO. · 2615 Washington Ave. · St. Louis 3, Mo.

Heat foiled again

and again

and again

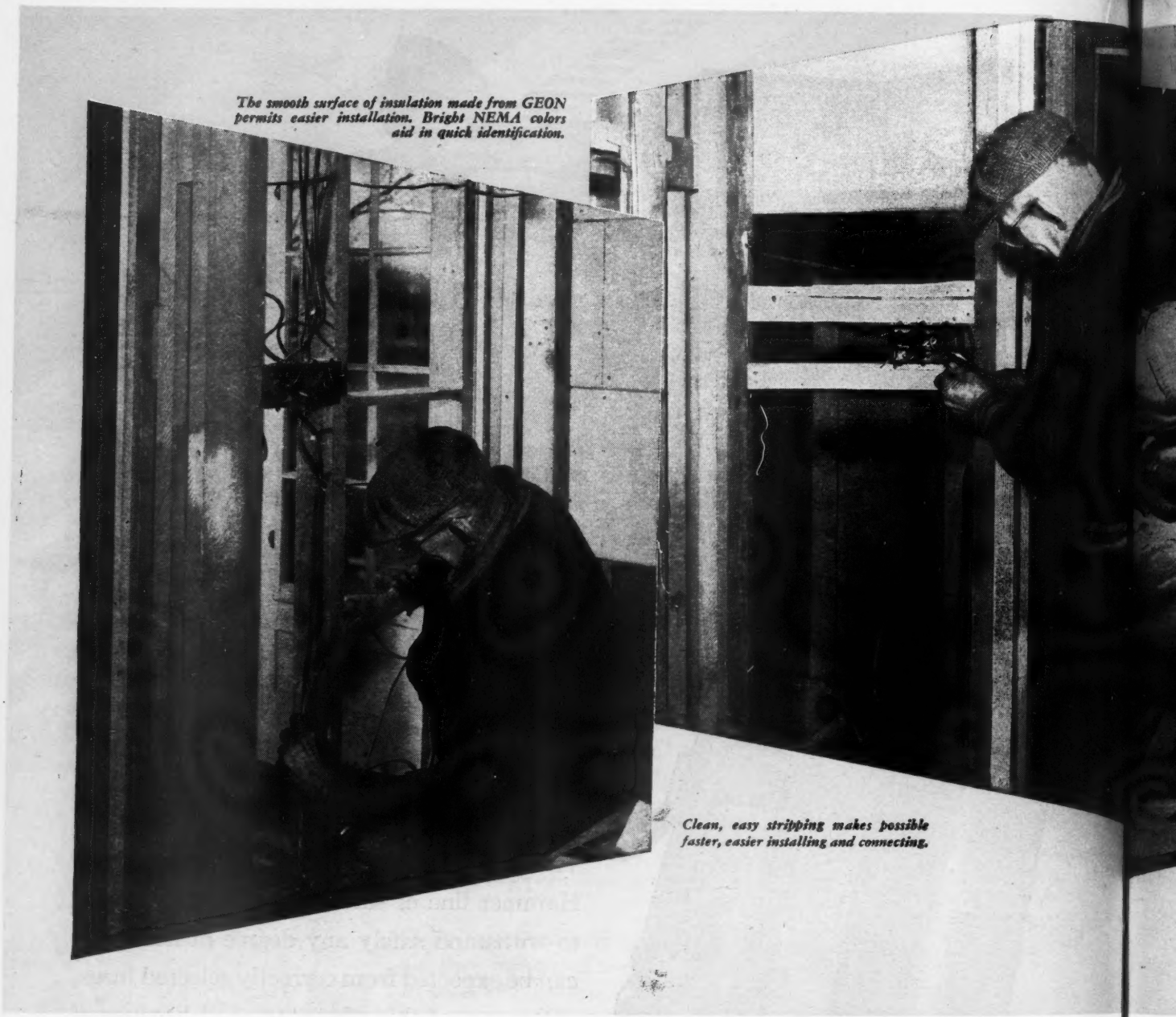
and again

The switch mechanism in the new Cutler-Hammer line of safety switches is designed to withstand safely any degree of heat that can be expected from correctly selected fuses.

Because of this advantage and because of the greater ease of installation and convenience of operation, because of proved performance and attractive appearance, Cutler-Hammer wholesalers and more and more alert contractors from coast to coast feature and recommend these outstanding switches. ... CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

By the New-

CUTLER-HAMMER
SAFETY SWITCHES
C-H



The smooth surface of insulation made from GEON permits easier installation. Bright NEMA colors aid in quick identification.

Clean, easy stripping makes possible faster, easier installing and connecting.

Wire insulated with Geon is everywhere

FROM basement to attic, this new house is wired with T and TW wire and non-metallic sheath cable, all insulated with GEON.

That's because wire insulated with GEON offers so many advantages—excellent electrical properties, to name one of the most important. Insulation made from GEON is flame resistant; increases safety, reduces fire hazard. Because of its outstanding electrical properties insulation made from GEON may be used in thin coatings which means more conductors per conduit. It's smooth, too, easy to handle and install; quickly identified because the entire NEMA color range is available. And, of course, it's Underwriters' approved.

As soon as the house is completed, more wire insulated with GEON will make its appearance. It may be in the form of appliance, lamp, and telephone wire. Or it may

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Wire insulation made from GEON has, of course, outstanding electrical properties. In addition, its flame resistance greatly reduces fire hazards.

Thinner coatings of insulation, made possible by the use of GEON, permit more conductors per conduit.

in this modern house

be the hookup wire now being used in modern radio sets and other electrical devices.

All of GEON's advantages are available to users in domestic, industrial or utilities wiring. The next time you order wire or cable from your supplier be sure to specify insulation made from GEON. Or for help with specific applications please write Dept. Y-9, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

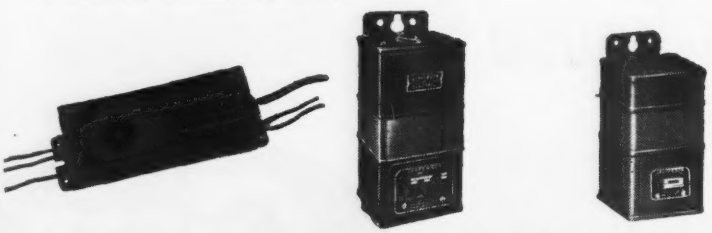
INTEGRITY

Lasting merit is a result of the maker's integrity applied to design, engineering, research, manufacturing.

During more than 30 years of unsurpassed performance, users of Jefferson Electric Transformers have come to place complete reliance in their fitness for the particular application—their long-life dependability, and uniformity of quality.

Increased production space—greater use of more modern machinery—experienced manufacturing technique with control of all in our own plant—assure still more the uniformity of quality that distinguishes all Jefferson Electric products.

Expanding output, with a greater supply of vital raw materials will make it possible to meet your requirements better than ever before. JEFFERSON ELECTRIC COMPANY, Bellwood (Chicago Suburb), Illinois. *In Canada:* Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.



Jefferson Transformers are available in all types and sizes to meet the most exacting needs.

JEFFERSON ELECTRIC

A FAMILY OF FIXTURES

and how it grew!

HOLDENLINE CHAN'L-RUN

All through the summer, the HOLDENline CHAN'L-RUN family of fixtures has been growing, growing in customer preference, growing in favor with wholesalers and contractors.

All HOLDENline CHAN'L-RUN fixtures have one outstanding exclusive family characteristic—the famous rigid steel channel that lets lighting men plan industrial lighting with basic units that can be converted from individual fixtures to continuous run, quickly, easily, economically.

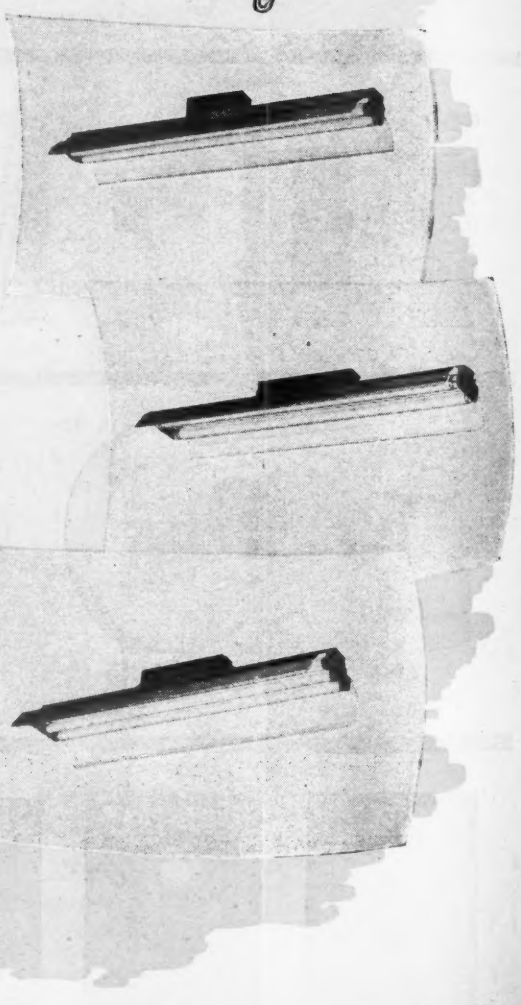
Four other HOLDENline CHAN'L-RUN features insure quick sales and lasting satisfaction.

1—High lighting efficiency—photometrically designed reflectors.

2—CHAN'L-RUN uses sturdy butt-on sockets exclusively. Mounted on and protected by heavy sheet steel plates. This insures correct lamp spacing at all times—field proven.

3—Complete flexibility and interchangeability are provided by HOLDENline BASIC-UNIT SYSTEM. Permits fast conversion to continuous run with a minimum expenditure of time, work, money.

4—Ample wire freeway.



TO HELP YOU PAINT THE NEW HOLDENLINE PICTURE

Mr. K. T. Beck
6544 Beaubien St., Detroit, Mich.
Mich.; N. W. Ohio

Mr. Harry C. Brown
2009 Holland Ave., Utica, N. Y.
N. Y. State

Mr. E. J. Busch
Standard Air & Lite Corp.
713 Penn Ave., Pittsburgh 22, Pa.
West. Pa., North W. Va.,
Southeast Ohio

Mr. Gerald A. Close
288 Dover Rd., Westwood Mass.
Maine, New Hampshire, Vermont, Mass., R. I., Conn.

Mr. Gene Hagen
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Pioneers in Fluorescent

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Division of ESSEX WIRE CORPORATION

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These pictures will give you an idea of the wide variety offered in the Penn-Union Catalog:

Grounding connectors, clamps, and studs for all combinations of pipe, rod, flat bar, braid, tubing.

Every one a thoroughly tested, dependable unit of protection for personnel and equipment . . . of ample capacity, high mechanical strength, and resistant to corrosion.

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Sold by Leading Jobbers

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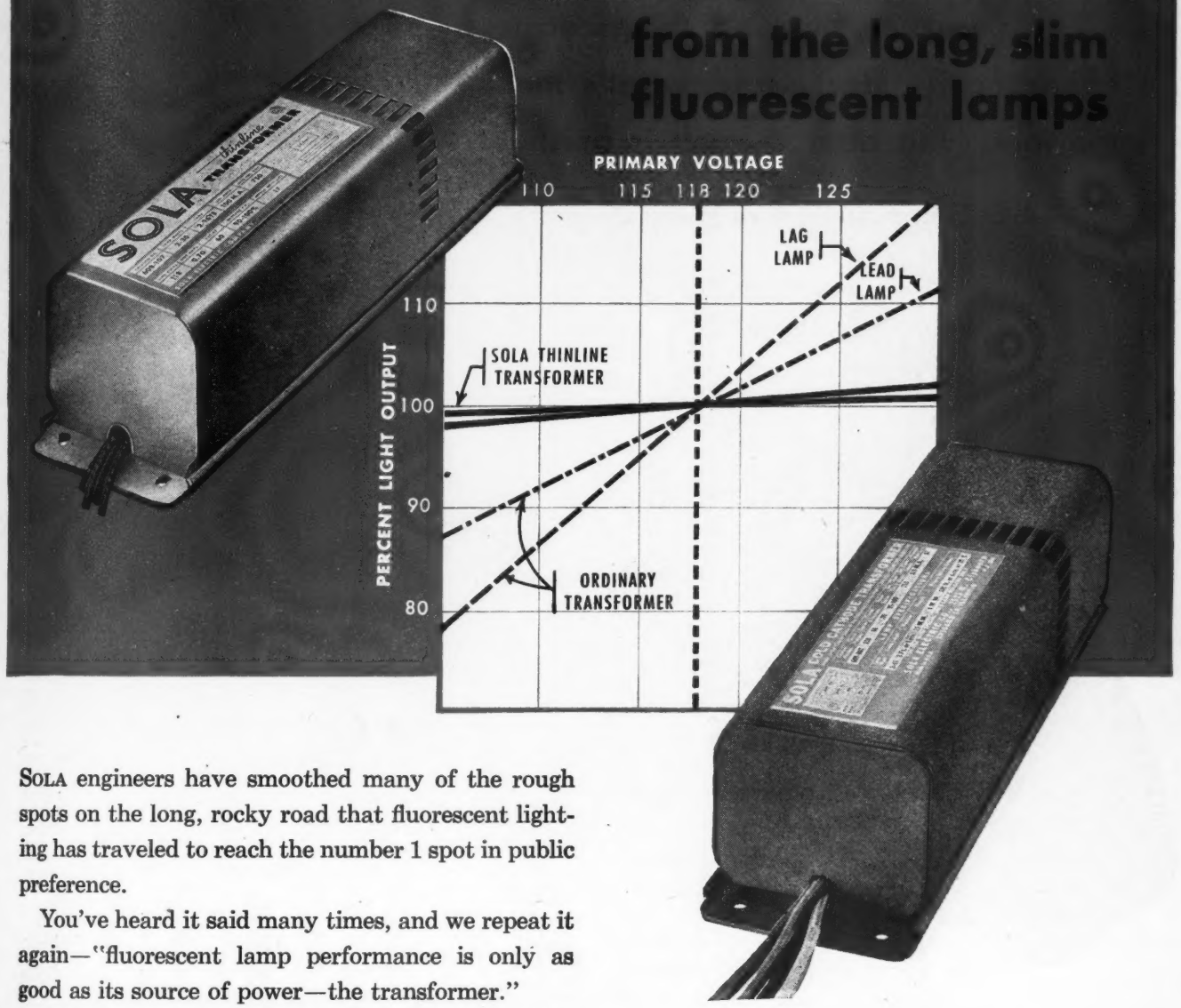
THE *Complete* LINE OF CONDUCTOR FITTINGS

PENN-UNION

CONSTANT LIGHT OUTPUT

from the long, slim fluorescent lamps



SOLA engineers have smoothed many of the rough spots on the long, rocky road that fluorescent lighting has traveled to reach the number 1 spot in public preference.

You've heard it said many times, and we repeat it again—"fluorescent lamp performance is only as good as its source of power—the transformer."

In designing these transformers for the operation of the long, slim fluorescent lamps SOLA engineers have incorporated the SOLA Constant Voltage principle, thus making it possible to maintain *Constant Light Output* from the lamps at all times regardless of wide variations in supply line voltage. Compare these transformers with any other make. Merely vary the primary voltage and read the confirmation on the light meter.

For cool, quiet operation specify SOLA transformers for every lighting installation. They are available in both single and 2-lamp types, housed in compact ventilated cases.

SOLA *Lighting* **TRANSFORMERS**

Lighting Engineers
Complete information and specifications available on request—
Ask for Bulletin [**JFL-110** **JCC-107**

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • etc. **SOLA ELECTRIC COMPANY, 2525 Clybourn Avenue, Chicago 14, Illinois**

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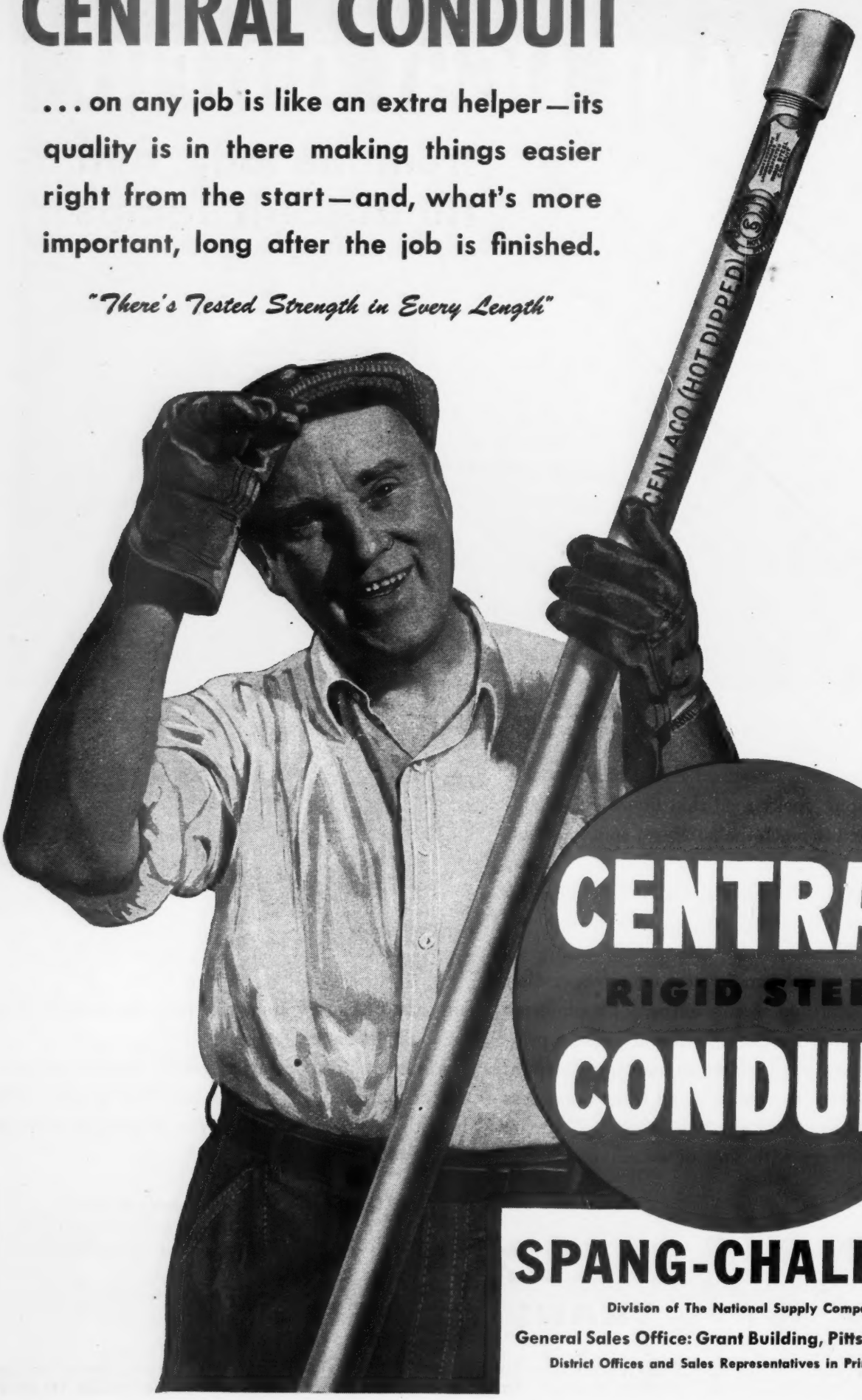
. . . on any job is like an extra helper—its quality is in there making things easier right from the start—and, what's more important, long after the job is finished.

"There's Tested Strength in Every Length"



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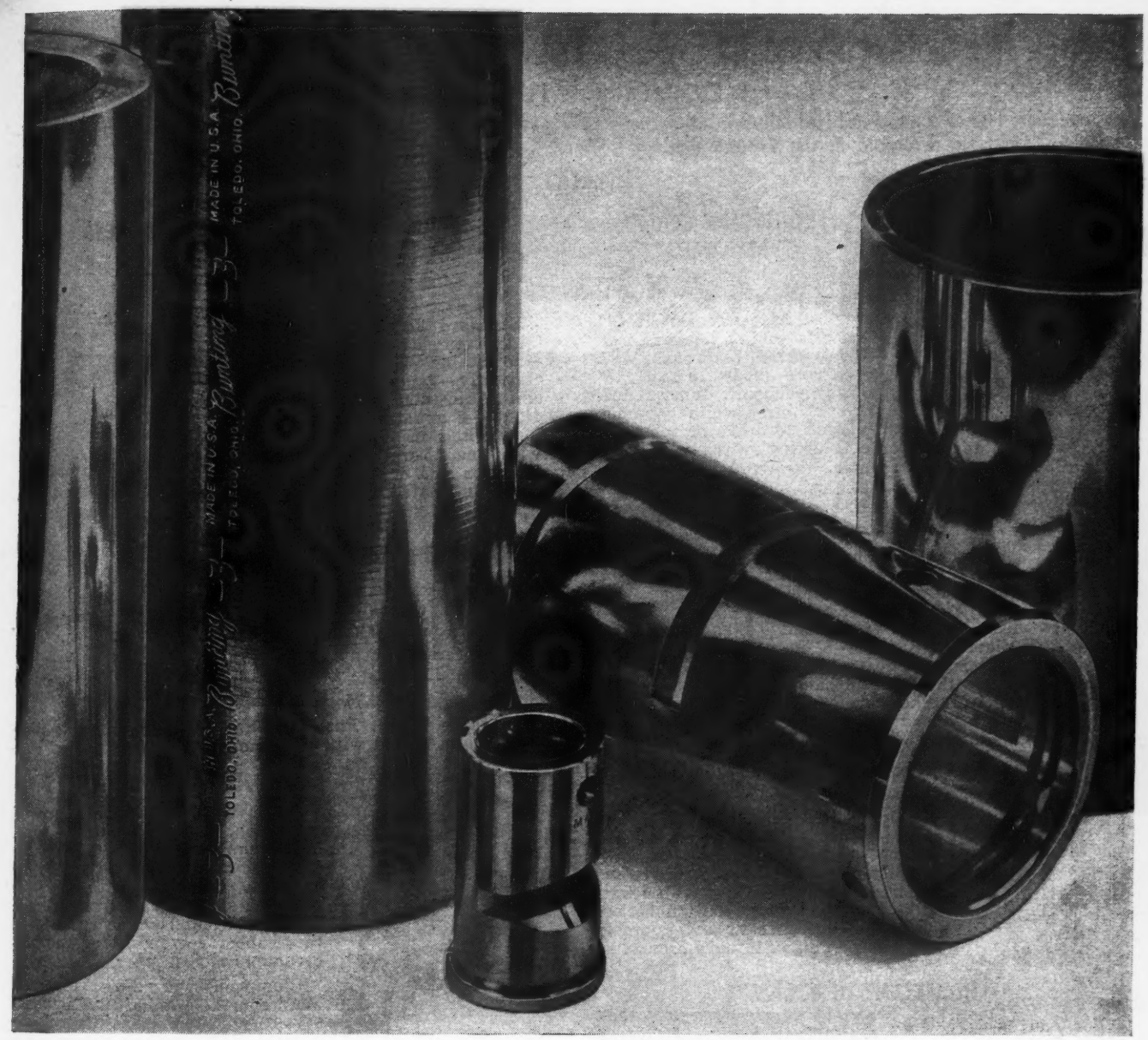

Bunting and Quality are synonymous in the field of Cast Bearing Bronze. Whether Bronze Bars or Bronze Bearings, Bunting Quality—controlled Quality—provides the exact answer. Available from complete stocks, carried by hundreds of Bunting Stock Carrying Distributors. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Branches in principal cities.

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Bunting

BRONZE BEARINGS ☆ BUSHINGS ☆ PRECISION BRONZE BARS

FARIES MANUFACTURING COMPANY

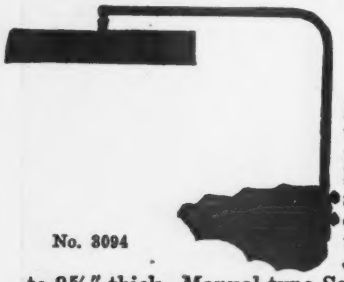
DECATUR, ILLINOIS

A complete line of commercial and industrial desk and floor lamps is available in the FARIES line.

Stenographers' Lamps, Examination Lamps, Hospital Lamps, Therapeutic Lamps, and many others.

Write for complete catalog.

FLUORESCENT CLAMP TYPE LAMPS



No. 3094

For one 15-watt T8, 18" Bulb—height over-all 22¼"—vertical adjustment up to 17" from bottom of shade to desk level—arm extension 18", swings — shade 18⅛x4⅛x3" on swivel joint. Inner reflector baked white enamel, clamps to desks or tables ⅝ to 2⅝" thick. Manual type Self starting switch—Available for A. C. or D. C.—brown ripple.

NATURAL LIGHT—SIGHT SAVING LAMPS

Swings right or left—arm has horizontal extension 16½ to 24½" from mounting point to center of shade. Over-all height 26½"—bottom of shade to desk level 18½"—metal shade 14" in diameter, 8" deep—8" inner reflector. Clamp fits desks 1¼ to 2" thick. Wired with switch in handy position at base of socket cover, 9' of rubber covered cord and unbreakable rubber plug. Statuary Bronze.

No. 1989

THE GUARDSMAN

No. 2223

Height 15½" overall—shade 12" in diameter—base 6½" in diameter—distance from bottom of shade to working plane 12". Inside reflector frosted aluminum. For use with a 100-watt bulb, wired with turn button socket, 9' rubber covered cord and unbreakable rubber plug. Statuary bronze.

FLUORESCENT DESK LAMPS

For one 15-watt T-8, 18" bulb. Height over-all 13⅞"—bottom of shade to desk level 11¾"—shade 18⅛x3½x2⅛"—inner reflector baked white enamel — base 10½x4½". Manual type self starting switch. Available for A. C. or D. C. Brown Ripple and Gold.

No. 3045

No. 3031

No. 3265

FLUORESCENT FLOOR LAMPS

For one 15-watt T-8 18" bulb. Height over-all adjustable 42½ to 60"—height to bottom of shade 37½ to 54½"—arm extension 18". Inner reflector baked white enamel—shade 18⅛x4⅛x3"—adjustable base 12" diameter. Manual type self-starting switch. Available for A.C. or D.C. Brown Ripple with Chrome Arm.

ADJUSTABLE and TELESCOPING FLOOR PORTABLES

Height to bottom of shade adjustable, 37" to 60"—flexible arm 11"—heavy felted base—dia. 9". Wired with 9' of rubber covered cord, key socket, unbreakable rubber plug, and No. 32 shade finished to match portable. White Enamel and Chrome—Statutory Bronze —Full Chrome—Brushed Brass.

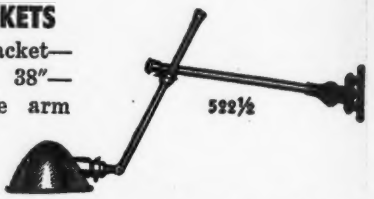
ADJUSTABLE FLUORESCENT BRACKETS

Standard 24" high—horizontal arm extends up to 24" swings —adjustable horizontally and vertically—flange base 3¾" in dia. Adjustable shade 18⅛ x 4⅛x3"—manual type self starting switch in shade. For use with one 15-watt T-8, 18-inch bulb, for A.C. or D.C. operation. Cadmium plated shade machine grey.

15300-01
15324-25

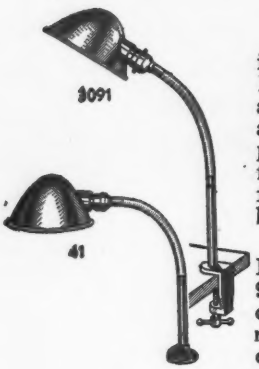
ADJUSTABLE BRACKETS

Adjustable Wall Bracket—maximum extension 38"—main arm 12"—shade arm 12". Universal joint at base — wrist joint at shade. No. 27-G shade 7" dia. Push socket, 6' cord, unbreakable plug —cadmium plated with machine grey shade.



522½

ADJUSTABLE BRACKETS



3091

41

Approved bracket with approved insulation. Bench or table type. Maximum height 25"—9" flexible arm—6" rigid stem. Heavy tripod at base. Complete with No. 27 parabola shade that swivels. Shade finished to match. Push socket—10 feet rubber covered cord, and unbreakable rubber plug.

Clamp on type adjustable lamp. Maximum height 25½". Phlexarm 9"—6" rigid stem—maximum clamp opening 2½". Parbola shade. Furnished with 9 feet of rubber covered cord—unbreakable rubber plug, push through socket.

DISTRIBUTING TYPE REFLECTORS

No. 27

has new one-piece snap-on holder—snaps over thread or bead on standard brass shell sockets—will not pull off until released but will allow shade to swivel. Dia. 6½" to 8". Parabola shade.

Other types and sizes available—write for complete catalog

FLEXIBLE ARMS

No. 154 . . . brass flexible arm—male thread each end ⅛" iron—outside diameter ⅝". Brushed Brass.

No. 540 . . . brass flexible arm for factory lighting—male thread each end ⅜" iron—outside diameter 11/16". Brushed Brass.

No. 154

FARIES LAMP AND FIXTURE PARTS

The following are available . . . Unit Holders, Socket Covers, Shade Holders, Adapters, Seating Rings, Bushings, Caps, Connectors, Nozzles, Nipples, Hickeys. Crowfeet, Chains, Spun Vase Caps, Finials, Knobs, Wall Plates, Bracket Racks, Canopies . . . practically any fixture part that is required.

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Unlimited SALES
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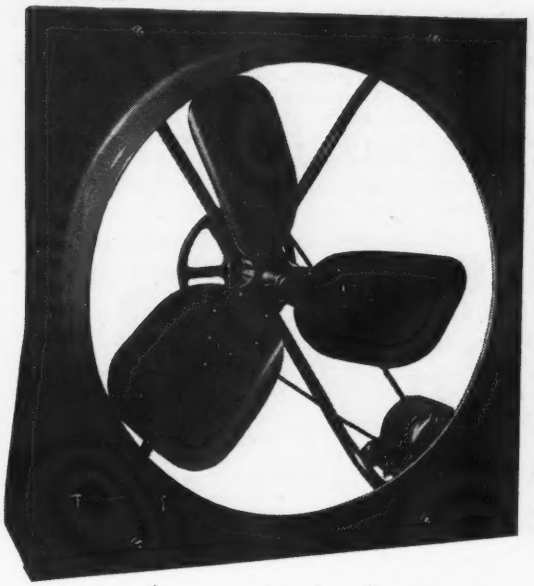
EXHAUST FANS
for Homes, Offices and Factories



5 Diameter Sizes
Range of 8 Discharge Capacities

Everyone wants comfortable, refreshing sleeping, working, and shopping conditions. Lau "Niteair" propeller-type fans provide more real, long-term comfort than anything that could possibly be devised or procured on such small investment. Installed in homes—large or little—Lau fans expel daytime heat; replace it with fresh, cool, night air. They have many practical applications besides homes—in offices, stores, restaurants, factories, commercial buildings and others. Mass manufactured in straight line production for low-cost competitive selling. Sales are a snap. Profit potential, great.

Exhaust hot air. Pull in cool, fresh air.

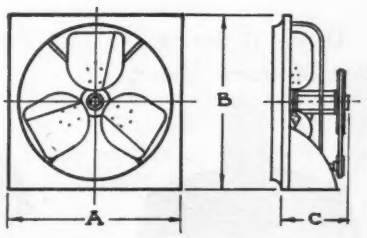
HUNDREDS OF APPLICATIONS

Here are a few—

Air-conditioning shops and offices
Removing dust-laden air in factories
Removing foul or contaminated air
Preventing dangerous fume penetration
(from one shop to another
or from shop to office)
Removing smoke from furnace rooms
Spot-cooling foundry workers

DIMENSIONS AND SPECIFICATIONS

Unit	Fan Size	A	B	C	C.F.M.	R.P.M.	H.P.
226L	22"	29	24½	11	3,800	700	1/6
304L	30"	38	38	13½	7,100	460	¼
364L	36"	42	42	13½	9,000	350	¼
363L	36"	42	42	13½	10,150	400	⅓
423L	42"	48	48	16	12,600	330	⅓
425L	42"	48	48	16	14,500	380	½
485L	48"	54	54	16	15,050	290	½
487L	48"	54	54	16	18,000	332	¾



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Engineers and fabricators of general Air Handling Equipment • Single Inlet and Double Inlet Blowers • Propeller Fans • Accessories

QUADRANGLE MANUFACTURING CO.

30 S. PEORIA STREET **CHICAGO, ILLINOIS**

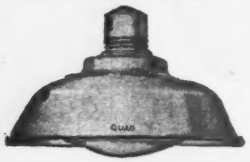
QUAD

The QUAD line of porcelain enameled reflectors is well known for its high quality of material and workmanship as well as the range of equipment offered. Representative material listed on this page includes several items certified by the Electrical Testing Laboratories of New York as complying with standard specifications of the RLM Standards Institute. Such certification is an additional assurance of quality.

The line includes also "economy reflectors" of good commercial grade. Prices quoted on application.

Sold through Electrical Wholesalers

Glassteel Diffusers



Threaded Type

Made in two sizes for lamps up to 500 watts with opal and Trutint (daylight) glass.

RLM Standard Dome

Socket Type

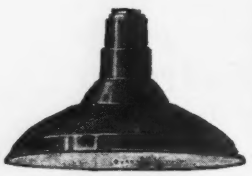
Socket Type for ½" or ¾" pipe. Six sizes for lamps up to 1,000 watts. Fitter type for lamps up to 200 watts, also made with shadeholders attached.

RLM Deep Bowl

Deep Bowl

Other Standard Shapes

Flat Cone



Shallow Bowl

Each of the above styles is made in socket and fitter types and with shadeholders for brass, porcelain and W.P. threaded sockets. Socket Reflectors are tapped for ½" or ¾" pipe and made for lamps up to 500 watts, 2¼" Fitter types for lamps up to 200 watts.

Q-D Reflectors and Socket Fittings

Special Dome

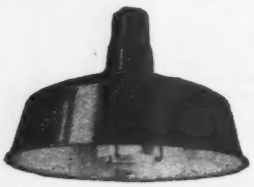
Type B

Socket Fitting for Outlet Box Mounting

Shallow Bowl

Reflectors shown have Type "V" vertical fitting for ½" pipe which is interchangeable with type "B" (center) or Type "H" shown on sign reflectors above to right. The Special Dome is made in five sizes up to 500 watts and the Shallow Bowl in four sizes up to 200 watts.

Dome Reflector For Mercury Vapor



Porcelain enameled green outside, white inside. Designed for the 400 watt high intensity mercury vapor lamp. Recommended for general industrial illumination. Its wide distribution characteristics combined with the shielding effect of the deep skirted reflector and opal glass diffusing ring make this a most practical unit for comparatively low mounting.

Post Top Reflector

Designed for the general illumination of outdoor locations where a practical fixture of good appearance is important. The unit consists of a green porcelain enameled reflector white inside, with ornamental knob, attached to an urn shaped cast aluminum socket housing by means of heavy cadmium plated iron rods. Three sizes of reflectors accommodate lamps from 200 watts to 1500 watt capacity.

Type "H" Socket-Fitting

Type "B" Socket-Fitting

QUAD AISLE-STOCK REFLECTORS

By properly disposed planes it reflects a wide spread of light downward and outward to each side of the aisle, and permits the escape of direct light to the upper tiers of shelving. Effective eye shielding is obtained by a lower light cut-off angle at each end of the reflector.

Quad Aisle-Stock Reflectors are accurately formed of heavy gauge steel, porcelain enameled white inside and outside. Four interchangeable styles of QD socket-fittings are available. Lamp size 50 to 150 watts.

Elliptical Angle Reflector

Made in QD socket type for lamps up to 1500 watts and in solid neck construction up to 200 watts.

Dust Tight Glass Cover

Covers are made in plain clear glass, daylight blue and heat resisting glass. Sizes range from 8" to 20" complete with impregnated felt gasket and cadmium plated ring for clamping to rim of reflector.

Sign Lighting Reflectors

Rectangular Type H

Spade—100 Watt

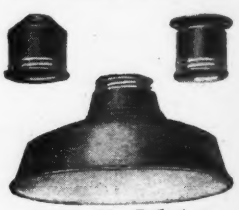
Round Angle Type H

Round and Rectangular reflectors have QD interchangeable sockets to take lamps up to 500 and 1000 watts respectively. Both Spade and Rectangular reflectors provide straight line light cut-off at top of sign.

Vaporproof Fixtures

A complete line of fixtures with and without reflectors. Made with dome, angle, shallow bowl and deep bowl reflectors with outlet box, vertical pendant or horizontal pipe fittings.

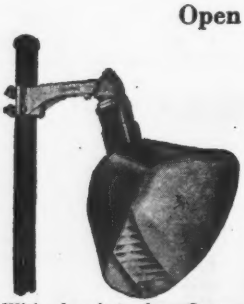
Heavy Threaded Reflectors



Removable Reflectors

RLM Dome shown includes sizes up to 1000 watts. Also made in shallow bowl, deep bowl and angle shapes up to 500 watts with threaded socket hoods.

Open Type Floodlights



With bracket for Open-Wiring—Can be mounted on 1½" to 2½" iron pipe, or on walls, wood poles or cross-arms.

This series of larger Quad Floodlights, made for the 750, 1000, 1500 watt lamps is adapted to all outdoor lighting where the maximum of diffuse light and wide angle light distribution are essential.

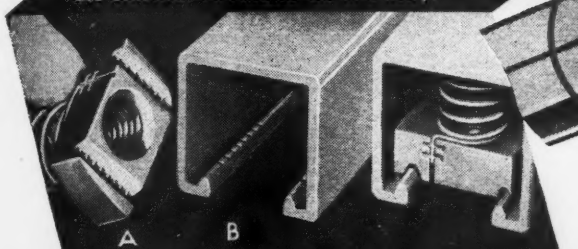
Floodlights have interchangeable auxiliary reflectors for beam control, note medium beam projector (left above) and long beam projector (right above). Lamp sizes range from 300 watts to 1500 watts. Multiple mounting brackets permit arrangements in banks of two, three or more.

SHORT CUT

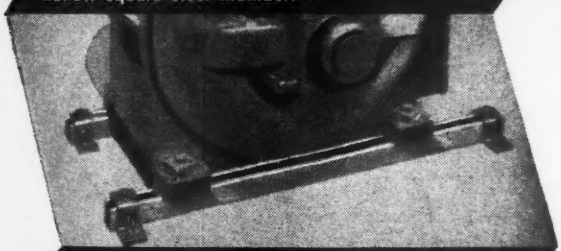
BUILD SUPPORTS— FRAMES *On the job!*

for BUS BARS and DUCTS, CABLES, CONDUITS, ELECTRICAL EQUIPMENT . . . without Drilling, Riveting or Welding

Need supports for cables or wiring . . . quick? Use UNISTRUT . . . makes 'em in a hurry!

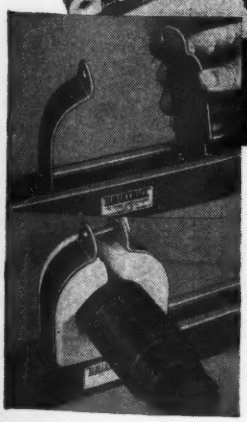


UNISTRUT consists of (A) spring-held nut attachments with teeth which bite into the turned-in edges of hollow-square section and hold attachments in any desired position; and (B) slotted hollow square steel member.



Need motor bases in a hurry? Or supports for electrical instruments or equipment? You can have them, pronto, with UNISTRUT.

UNISTRUT cable clamps, porcelain or maple, for conduit or cable, are used with standard UNISTRUT.



Pipe clamp straps are inserted as shown at any point or points in the UNISTRUT member, insulators placed against the cable or conduit. A single bolt clamps insulators around the conductor, and locks the whole installation tightly to the UNISTRUT member.

"UNISTRUT"

THE ALL-PURPOSE METAL FRAMING

On all sorts of electrical jobs you can build frames, hangers, supports, without any drilling, riveting or welding . . . with UNISTRUT. Only three quick, easy steps. 1. Cut UNISTRUT to desired length. 2. Locate fitting and nut at desired point. 3. Bolt securely with a turn of the wrench. So simple! So fast! UNISTRUT saves time and money . . . 100% Adjustable and Re-usable. Made in four sizes and three gauges. Find out today about this short cut.

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Cable and Conduit Supports . . . Bus bar supports, hangers, etc . . . Switch and panel board supports . . . Motor Starter and switch box supports . . . Motor bases, adjustable . . . Bus and switch cell structures . . . Power Duct System supports . . . Outdoor and indoor sub-stations . . . Disconnecting switch and barrier supports . . . Lighting system supports.

Stocks in Chicago, Buffalo, Detroit, Los Angeles, San Francisco, St. Louis, Houston, Denver, Philadelphia.

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THE MAN-SIZED METAL BUILDING SET

UNISTRUT PRODUCTS CO.

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DOUBLY PROTECTED ... from accidental grounding or shorting

BullDog Ventilated LO-X BUStribution Systems

VENTILATED "Lo-X" BUStribution Duct, manufactured by BullDog Electric Products Company, Detroit, makes plant layout flexible because it gives access to adequate power supply up to 4000 amp., wherever it is needed. Wide, flat bus bars supported by porcelain insulators are arranged in closely spaced, paired phase design to assure low voltage drop by reducing reactance loss.

The expanded metal enclosure of Ventilated "LO-X" BUStribution Duct simulates the effect of bus bars in open air, thus reducing temperature rise. The principal dielectric is air, which is the only insulation that has the faculty of restoring its dielectric properties when and if a power arc occurs. Bus bars are machine wrapped with *Natvar* seamless bias varnished cambric tape because of its high uniformity and because it gives the required balance of high dielectric and high mechanical strength.

If you require insulating materials with good physical and electrical performance characteristics and exceptional uniformity—plus prompt delivery—plus service, it will pay you to use Natvar. Get in touch with your Natvar wholesaler or with us direct. Write, wire or phone.

Natvar

- Varnished cambric — straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing
- Extruded vinyl identification markers

Write for Catalog No. 20

THE NATIONAL VARNISHED PRODUCTS Corporation

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CABLE ADDRESS
NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

Chelsea Ventilating Coolers for Home, Office, Factory or Store!

MEMBER PROPELLER FAN MANUFACTURERS ASSOCIATION

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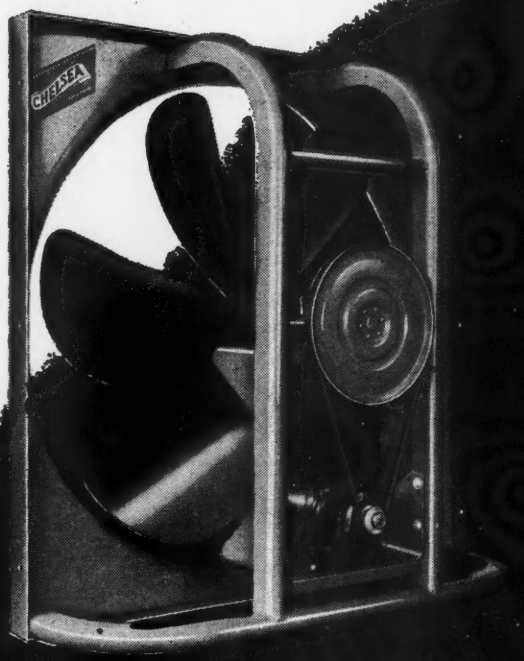

TYPE IND STREAMLINED INDUSTRIAL FAN:

TYPE ED STREAMLINED ATTIC FAN:

rolled-
under static
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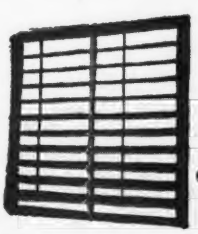
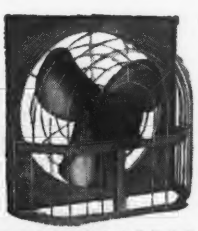
totally enclosed ball-
Moving parts are rubber

cushioned.

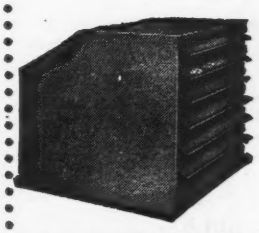
INVESTIGATE THESE WIDELY-USED CHELSEA VENTILATING UNITS



Type LWL Automatic Louvers: For general ventilation installations. Protects fan when not in use. Aluminum leaves pivoted in machined brass to reduce friction; tie rods cadmium plated bushings. Larger units dual to eliminate twisting of leaves.

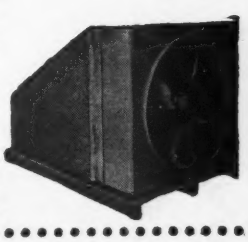


Type AA Utility Fan: For cold storage, meat packer and freezer applications. Totally enclosed ball bearing motor with both front and rear guards. Capacity: AA20 — 3000 CFM; type AA24—4800 CFM. Fan speed—1100 rpm.



Type PH Penthouse Roof Ventilator: For roof ventilation. Operates against static pressures using the IND type industrial fan housed in steel penthouse with automatic shutters. Completely assembled—ready for installation.

Type P and MC Pedestal Fans: For shops, offices, stores, and factories. Rugged construction with steel die-stamped blades. Motor and fan shaft ball bearings. All parts protected against rust. Available in a wide range of sizes.



Type EU Package Attic Fan Unit: For cooling homes, churches, hotels, hospitals, schools, etc. New streamlined venturi orifice delivers greater air volume. ASH and VE method certified ratings. Efficient, low current consumption motors.

CHELSEA **CHELSEA PRODUCTS**

1206 GROVE STREET, IRVINGTON, NEW JERSEY

MERCOID

The Only 100% Mercury Switch Equipped Controls

FOR HEATING, AIR CONDITIONING, REFRIGERATION AND VARIOUS INDUSTRIAL APPLICATIONS

There is scarcely an industry that is not using a Mercoid Control somewhere on vital applications in the control of temperature, pressure, liquid level, mechanical operations, etc. ★ The reason is based on their record for dependable operation and long service. They are easy to install, adjust and require practically no attention ★ The hermetically sealed mercury switches used in all Mercoid Controls are dust, dirt and corrosion-proof, thus assuring positive performance under all operating conditions. These mercury switches are also available to the trade in various types for different applications ★ If you have a switch or control problem, let Mercoid engineers give you the benefit of their wide experience.

Below are a few items briefly described. See catalog No. 600 for the complete line and further information. A copy will be sent upon request.

THERMOSTATS

Various types available for both low and high voltage applications. All types excepting the line voltage type are known as Mercoid Sensatherms, including the regular, Day and Night, Two Stage and dual. All Mercoid thermostats are noted for their close air temperature control.

VISAFLAME CONTROL SYSTEM

(Actuated by Light)

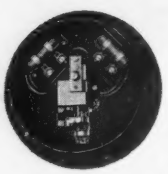
For domestic and industrial oil burners. It operates direct from the light of the flame. Among its many desirable features is the fact that it may be built within the burner unit—a step ahead in oil burner controls.

REMOTE STEM TEMPERATURE CONTROLS

For control of liquids or gases, such as air, oil, water, paraffin, glue or distillate vapors and many other industrial applications. The control is equipped with convenient outside double adjustments.

EXPLOSION-PROOF CONTROL CASES

For use with various Mercoid Controls to be installed in hazardous locations, such as oil refineries, ammunition plants, flour mills, or where dust or vapors form an explosive mixture with air.



DIAPHRAGM CONTROLS

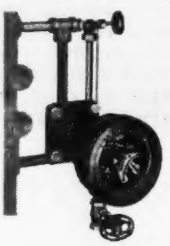
For low pressures where regulation is required in inches of water, either pressure or vacuum. They are used to regulate gas pressures, as safety or signalling devices; also with air circulating fans on recirculating ovens, etc.

LEVER ARM AND FLOAT CONTROLS

These controls have a variety of applications where it is desired to mechanically open and close electric circuits. Mercoid float controls are used for maintaining fluid levels in tanks or for control of sump pumps or cellar drainers. The counterbalanced type is used on tanks where there is a surge in liquid. The plunger type is used on closed tanks.

PRESSURE CONTROLS

For numerous industrial applications. The outside double adjustments eliminate guesswork when setting controls. Indicators show the operating range on the calibrated dial. Available in many pressure ranges for direct or remote connections.



COMBINATION PRESSURE AND LOW WATER CONTROL

For the protection of automatically fired steam boilers to prevent the hazard of firing into dry boilers, also guards against building up excess steam pressure. Equipped with quick hook-up fittings. Various other types of low water controls available.

TRANSFORMER-RELAYS

Type V is a reliable low voltage mercury contact relay which also acts as a transformer inducing low voltage (24 volts) on the pilot circuit. There is no hum or chatter. Used for all types of automatic equipment. Available in various voltages, cycles and circuits.

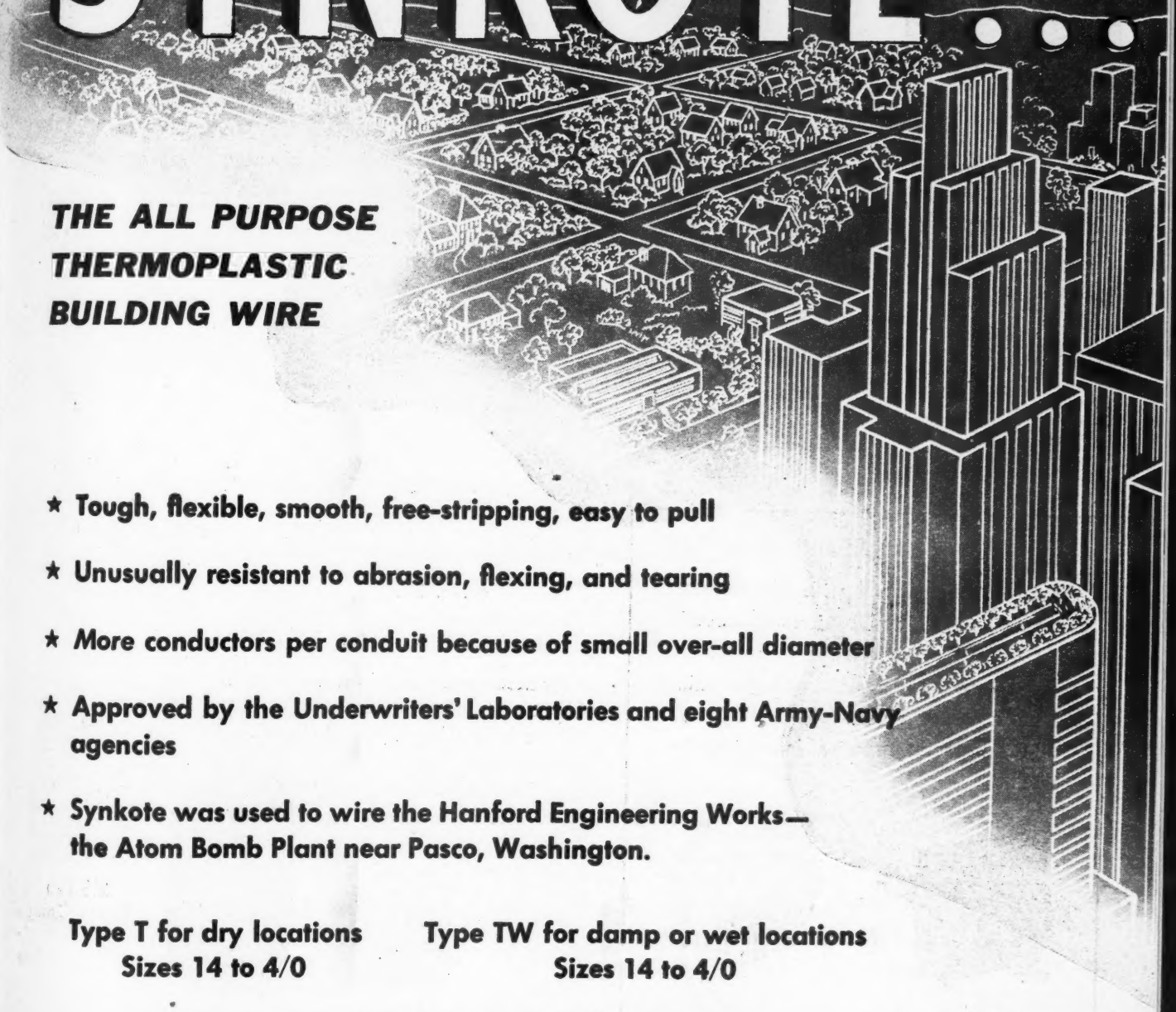
THE MERCOID CORPORATION, 4201 BELMONT AVE., CHICAGO 41, ILL.

★MERCOID CONTROLS

BUILT TO ENDURE

The Wire for Today

SYNKOTE*



THE ALL PURPOSE THERMOPLASTIC BUILDING WIRE

★ **Tough, flexible, smooth, free-stripping, easy to pull**

★ **Unusually resistant to abrasion, flexing, and tearing**

★ **More conductors per conduit because of small over-all diameter**

★ **Approved by the Underwriters' Laboratories and eight Army-Navy agencies**

★ **Synkote was used to wire the Hanford Engineering Works— the Atom Bomb Plant near Pasco, Washington.**

Type T for dry locations
Sizes 14 to 4/0

Type TW for damp or wet locations
Sizes 14 to 4/0

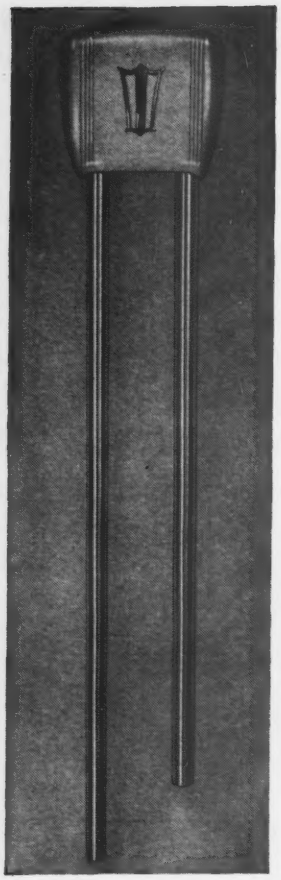
Both types come in fifteen distinctive, lasting colors (including the full N.E.M.A. range).

*Reg. U. S. Patent Office

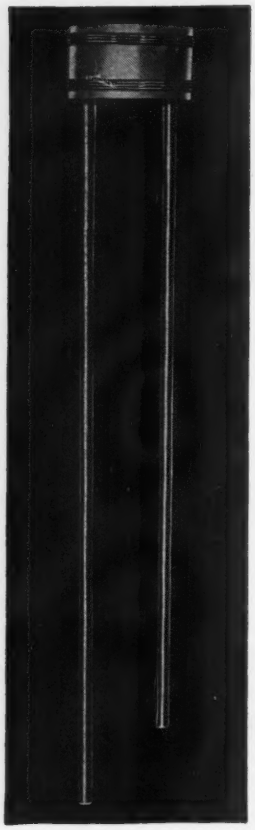
SYNKOTE...a product of the PLASTOID CORPORATION

9 West 44th Street • New York 18, N. Y. • Factory: Hamburg, N. J.

LIBERTY DOOR CHIMES



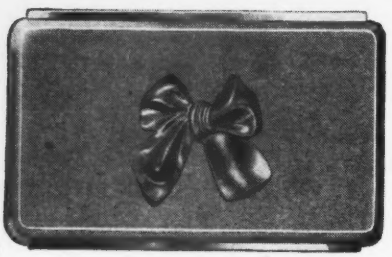
No. 86



No. 96

• Compare these Liberty chime mechanisms with any other make. There is no skimping of materials . . . units are sturdily constructed to stand years of satisfactory service. With exception of the No. 3-E, these chimes are shipped complete with chime transformer to eliminate guesswork in installation.

These chimes create immediate acceptance. Cases are in lustrous ivory plastic, gleaming hand painted ceramics and enameled steel, all with polished brass medallions. Tubes are finished in brush brass.

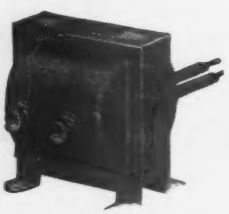


No. 3-E

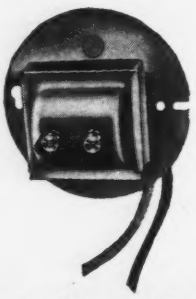
Write for special chime catalogue

BELL TRANSFORMERS

Built in accordance with transformer standards and Underwriters approved. Deliver full rated voltage and current, 10 volts at 5 watts. Will operate bells, buzzers and 10 volt chimes through 125 feet annunciatore wire exceptionally well.



Cat. No. 212-B
Less Cover



Cat. No. 212-B

DOOR BELLS AND BUZZERS

New modern designs in douuble coil bells, 2½ to 6" all with copper-nickel plated mirror finished gongs and silver contacts. Combination and enclosed type bells also heavy duty #89 6 and 8" bells.

2½ Bell
Dome Gong

Buzzer

No. 20

The LIBERTY BELL MANUFACTURING Co.
MINERVA, OHIO

Design Unshackled!

ALZAK* ALUMINUM'S EASY

Formability GIVES YOU FREE REIN!

The formabilty of Alcoa Aluminum Reflector Sheet gives you freedom of design; the metal is readily formed, spun, or drawn to carry out your own individual ideas for reflector or fixture design . . . and lighting efficiency. This formability is a big plus, when you add it to the other advantages of Alzak Aluminum Reflectors: corrosion and heat resistance, surface stability; in short, *sustained high efficiency*, for either specular or diffuse applications.

Consult your reflector manufacturer regarding specifications for Alzak Aluminum, or other finishes of Alcoa Reflector Sheet. ALUMINUM COMPANY OF AMERICA, 1946 Gulf Bldg., Pittsburgh 19, Pennsylvania. Sales offices in principal cities.

*PATENTED PROCESS

NEW CURTIS LUMINAIRE USES ALZAK ALUMINUM

For offices, drafting rooms, schoolrooms, the new Curtis "Forty-Sixty" Luminaire makes use of Alzak Aluminum's efficiency to direct approximately 40% of the light upward, 60% downward, provide ideal working light.

ALCOA ALUMINUM

ALCOA ALUMINUM

IN EVERY COMMERCIAL FORM

FEATURING all-round job efficiency!

ACCURATE TAPES

Asked for by name by users everywhere—proof of the economy and dependability of ACCURATE tapes.

Tested and approved by industry for over twenty-five years—your guarantee of maximum service

FOR over twenty-five years, high quality ACCURATE tapes have been a consistent repeat sales item. Users ask for them by name and for good reason, for these tapes wrap fast, stick permanently . . . provide a smooth, lasting, protective covering with a minimum of effort. Also, ACCURATE friction tapes are non-raveling, strong. They tear off clean and are super-calendered for through and through impregnation. ACCURATE rubber tapes—highly elastic—provide maximum dielectric strength in a minimum space. Materials used in both types are supplied to exacting specifications, and are rigidly inspected prior to use—your assurance of absolute dependability and satisfaction. All tapes available on short notice . . . in any quantity. Your inquiries are invited.

FEATURING, also, important field-tested improvements—both electrical and mechanical—that lower job costs through speedier, easier, installation!

ACCURATE MFG. COMPANY

OVER A QUARTER CENTURY OF TAPE SPECIALIZATION

GENERAL OFFICES and PLANT: GARFIELD, NEW JERSEY

RELIANCE *Automatic* Time Switches are America's Reliable 24 Hour-a-day Guardians

The dependability of RELIANCE Automatic Time Switches has been proved in emergency as well as in normal times. They are giving complete and reliable service under many and varied conditions—a factor of paramount importance particularly in these times when constant good service is so essential. RELIANCE Switches are easy to install, economical in operation, and meet a wide variety of needs. Catalogs and price sheets are available on request.

ASTRONOMIC TIME SWITCH

The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of resetting the dial as the days become longer or shorter.

BADGER Synchronous Automatic TIME SWITCHES

This model is specifically a heavy duty time switch with a capacity great enough to meet a wide variety of requirements. A slow speed, heavy duty self-starting synchronous motor consuming less than 3 watts comprises the time element and assures absolute accuracy. Standard motors are for use on 110-125 volt, 60 cycle A.C., but 50 cycle and 250 volt motors can be furnished at the same prices. The four types listed below are comprised of different combinations of single and double pole switches and enclosed in cast iron or 16 gauge sheet steel cases. Cast iron case is fully gasketed, weatherprooof and padlockable.

Sheet steel case is not gasketed or padlockable. Combination knockouts for ½ and ¾ inch conduit at bottom and sides. Size 5½ x 10¼ x 4½ inches deep. All types are single throw (straight "on" and "off").

Type	Poles	Capacity	Case
M1	1	50A., 125V	16 Ga. Steel
M2	2	50A., 125/250V	16 Ga. Steel
RM	1	50A., 125V.	Cast Iron
RM5	2	50A., 125/250V.	Cast Iron

RELIANCE Automatic TIME SWITCHES

An extremely simple, compact, economical, and dependable time switch which, with only five types, covers practically every requirement.

Heavy silver contacts are rated at 30 amp. per pole at 125-250 volts. Case is of 20 gauge steel finished in black shrivel enamel. Combination knockouts for ½ and ¾ inch conduit are furnished at back, bottom and sides of case. Size 4 x 7 x 4 inches deep.

Type	Poles	Throw	Capacity
W-11	1	Single Throw	30 A. at 125V.
W-22	2	Single Throw	30 A. at 125/250V.
W-33	2	Two Circuit	30 A. at 125/250V.
W-11A*	1	Single Throw	30 A. at 125V.
W-22A*	2	Single Throw	30 A. at 125/250V.

* Astronomic Type

for additional information write

RELIANCE AUTOMATIC LIGHTING CO.

1907 Mead Street **Racine, Wisconsin**

The Electrician at Work is

WHAT Q-FLOOR SELLS

The whole idea of Q-Floor is electrical availability. The floor is steel, honeycombed with cells crossed over by raceways. Every square foot of the exposed floor can sprout electrical outlets.

Underwriters' Laboratories Inc., have approved Q-Floor for any type of wiring, in accordance with article 356 of the National Electrical Code.

Building owners look upon Q-Floor as protection against electrical obsolescence because the very nature of the floor encourages continuous electrical change. Floor layouts are revised as often as electrical requirements change. Of course, this calls for continuous electrical maintenance, but, in the long run, it is more economical to keep an electrician continuously busy than it is to reduce the earning power of a building because of electrical inadequacy.

H. H. ROBERTSON COMPANY

2400 Farmers Bank Building, Pittsburgh 22, Pennsylvania

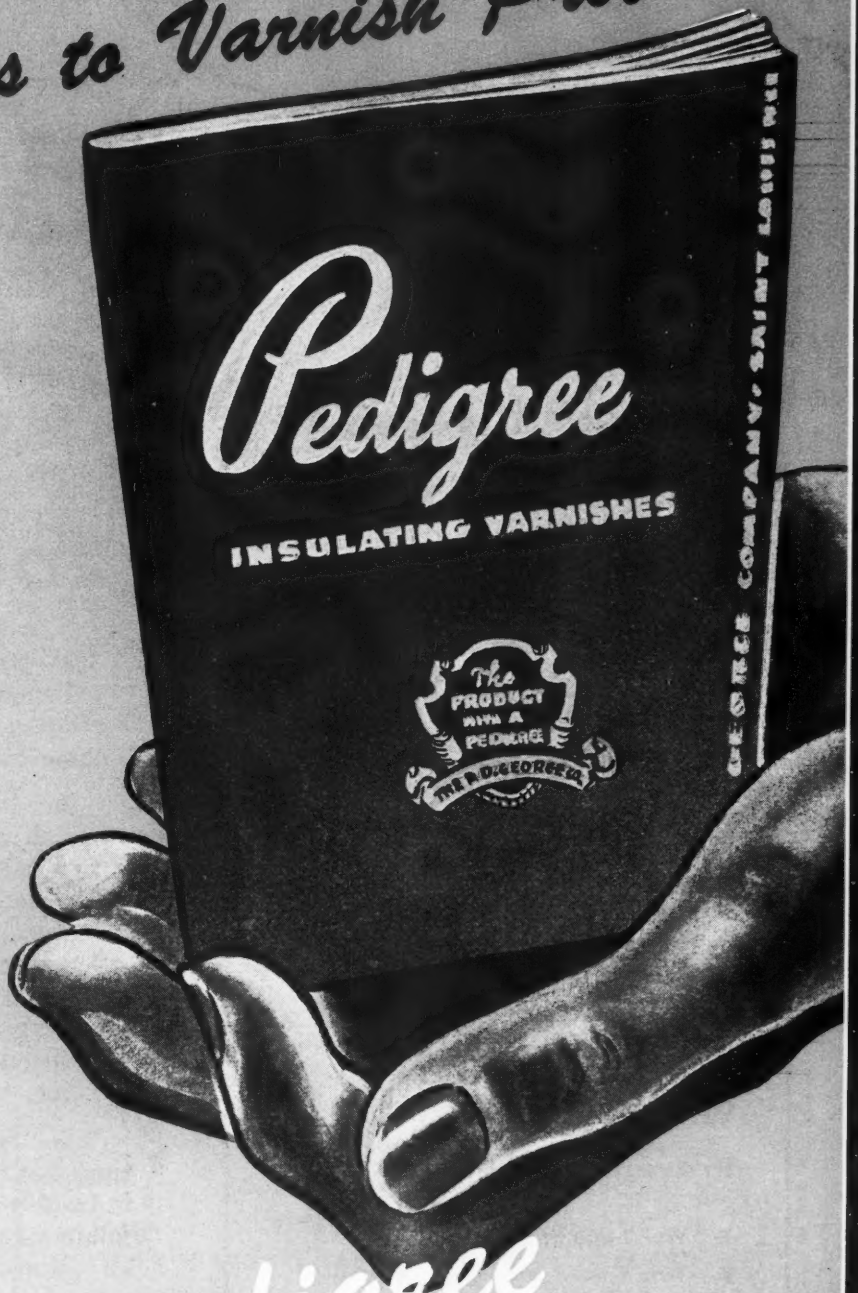
Offices in 50 Principal Cities World-Wide Building Service

Electrical fittings for use with Robertson Q-Floors can be obtained from General Electric Construction Materials distributors. See the nearest G. E. merchandise distributor for information on how Q-Floor fittings can be used to attain up-to-the-minute electrical wiring.

Q-FLOORS AND ELECTRICIANS ARE PARTNERS

in the business of keeping buildings young

IN THE PALM OF YOUR HAND
answers to Varnish Problems



You can use your free copy of this big catalog in finding the exact varnish for nearly every requirement. It's filled with helpful information and descriptions of many different Pedigree Varnishes, each a favorite because of its outstanding performance. If your requirements necessitate the formulation of a special varnish, the Pedigree Industrial Laboratory is at your disposal.

Pedigree Varnishes

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INSULATION MANUFACTURERS CORPORATION | **INSULATION AND WIRES INCORPORATED** | **TRI-STATE SUPPLY CORPORATION**

Manufactured by

THE P. D. GEORGE COMPANY, ST. LOUIS, U. S. A.

TO PROTECT CIRCUIT OPERATION, REDUCE BREAKDOWNS, CUT MAINTENANCE

A few of the 125 Rockbestos constructions.

Rockbestos A.V.C. Power Cable

Rockbestos A.V.C. Boiler Room Wire

Rockbestos A.V.C. Switchboard Wire

...wire with ROCKBESTOS A.V.C.

Wherever heat shortens wire life... in factories, mills and generating plants... Rockbestos A.V.C. reduces costly power, control and lighting circuit maintenance by eliminating wire failures.

Insulated with heat and flame resistant impregnated asbestos these *permanently insulated* wires and cables permit continuous operation under high temperatures and other failure-creating conditions. They protect power supply, keep overloaded motors running and apparatus operating because they take heat and moisture without baking out, cracking or flowing . . . and resist the destructive attack of fumes, oil, grease and even flame.

When rewiring circuits or putting in new installations use Rockbestos A.V.C. wires, cables and cords in trouble-making locations. They will prevent wire-failures and equipment outage and save money in circuit maintenance.

Rockbestos A.V.C. constructions in 600 to 5000 volt ratings include single and multi-conductor power cables, switchboard and lighting wires, control cables and N.E. Code types. Write for a catalog which describes them and various Rockbestos All-Asbestos insulated wires and cables.

ROCKBESTOS PRODUCTS CORPORATION
205 Nicoll St., New Haven 4, Conn.

9 Reasons Why Rockbestos A.V.C. Prevents Wire-Failure

1. Won't age or deteriorate
2. Won't bake brittle, crack or flow under heat
3. Won't burn or carry flame
4. Corrosive fumes won't rot it
5. Remains permanently flexible
6. Resists oil, grease and moisture
7. Withstands conductor-heating overloads
8. Gives greater current carrying capacity
9. Reduces circuit maintenance expense

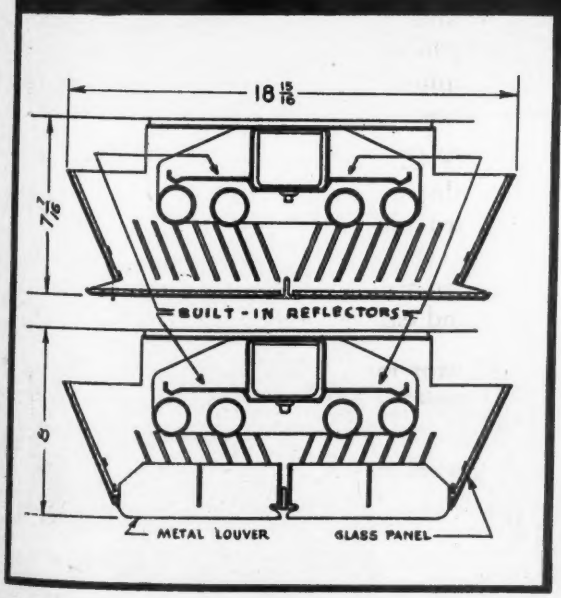
These characteristics are built into 125 Rockbestos constructions including the wires illustrated.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK BUFFALO CLEVELAND CHICAGO
PITTSBURGH ST. LOUIS LOS ANGELES
SEATTLE SAN FRANCISCO PORTLAND, ORE.

For over forty years, architects, contractors and illuminating engineers have been specifying and relying on Solarite "know-how" to develop and execute their lighting requirements.



Specifications

SOLARITE RESEARCH
Model No. A5448
GLASS BOTTOM

Fixtures to be the URC type for 2, 4 or 6, 40-watt Fluorescent lamps with brick type high power factor 2-lamp ballast, mounted in steel channel and with one-piece white baked enamel reflector covering bottom of channel and the tops of all lamps to be removable without tools. Lamp holders are to be standard rotating type rigidly held to steel cross member of ballast channel, lamp holders replaceable without taking down fixture. The bottom of fixture to have two clear prismatic ribbed glass panels, each 4 feet long; also side panels of same texture with smooth side ceramic finish permitting a light transmission of only 30%, with surface brightness not to exceed 0.70 C. P. per square inch.

A steel and plastic center bar of inverted "T" cross-section shall lock to and connect bottom of the steel end plates to form a rigid frame. Fixtures shall be capable of being installed and connected mechanically and electrically end to end. The fixtures for two lamps to be A-5248; for four lamps, A-5448; for six lamps, A-5648, as made by SOLAR LIGHT MANUFACTURING CO., or approved equal.

SOLARITE RESEARCH
Model No. 8448
LOUVERED BOTTOM

Fixtures to be the URC type for 2, 4 or 6, 40-watt Fluorescent lamps with brick type high power factor 2-lamp ballast, mounted in steel channel and with one-piece white baked enamel reflector covering bottom of channel and the tops of all lamps to be removable without tools. Lamp holders are to be standard rotating type rigidly held to steel cross member of ballast channel, lamp holders replaceable without taking down fixture . . . the bottom of fixture to have two hinged louvers egg-crate design with a minimum transverse shielding angle of not less than 40 degrees and longitudinal of 30 degrees; also side panels of same texture with smooth side ceramic finish permitting a light transmission of only 30% with surface brightness not to exceed 6.70 C. P. per square inch.

A steel and plastic center bar of inverted "T" cross-section shall lock to and connect bottom of the steel end plates to form a rigid frame. Fixtures shall be capable of being installed and connected mechanically and electrically end to end. The fixtures for two lamps to be A-5248; for four lamps, A-5448; for six lamps, A-5648, as made by SOLAR LIGHT MANUFACTURING CO., or approved equal.

SOLAR LIGHT MANUFACTURING CO.
1357 S. JEFFERSON ST.
CHICAGO 7, ILLINOIS

No electrical equipment can be any better than its insulation

Because of its excellent weather resistance, this insulating varnish was used for all kinds of war communications equipment . . .

G-E INSULATING VARNISH 9564

A clear synthetic resin varnish . . . may be air-dried or quick-baked . . . for heavy-duty communications equipment

. . . and the same varnish is now being used for protection in peacetime communications systems far and wide.

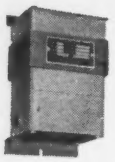
GENERAL ELECTRIC'S unrivaled facilities for synthetic resin insulating varnish research, development and manufacture are now available to all who make or repair electrical equipment. Be sure of product uniformity, by virtue of G-E Quality Control—specify G-E Insulating Varnishes. For full details consult your local General Electric Merchandise Distributor. Or write direct to Section RIMA-965, Resin and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

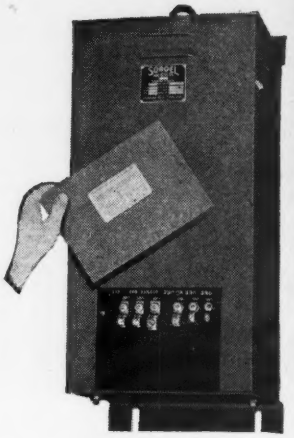
CD46-16

G. E. OFFERS A COMPLETE LINE OF INSULATING MATERIALS

SORGEL AIR-COOLED TRANSFORMERS



¼ KVA.
Single Phase
460/230 to
115 volt.



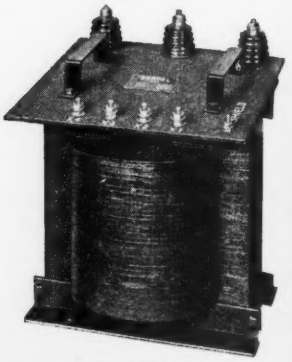
15 KVA. 3-phase
Showing connection
compartment with
solderless terminals

for Every Purpose

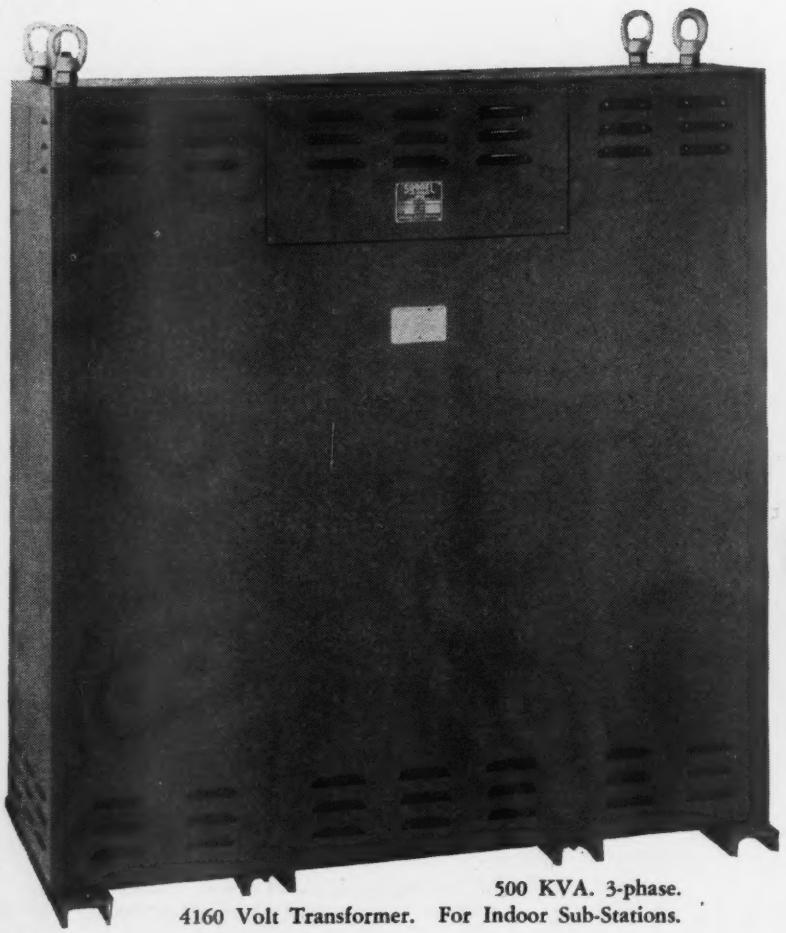
To operate 115 volt lighting and portable equipment
from 230-460 or 575 volt power circuit.
¼ to 333 KVA. Single phase. 1 KVA to 1000 KVA. 3-phase.

To operate special equipment from standard circuits,
to change odd voltages to standard voltages, and phase changing.

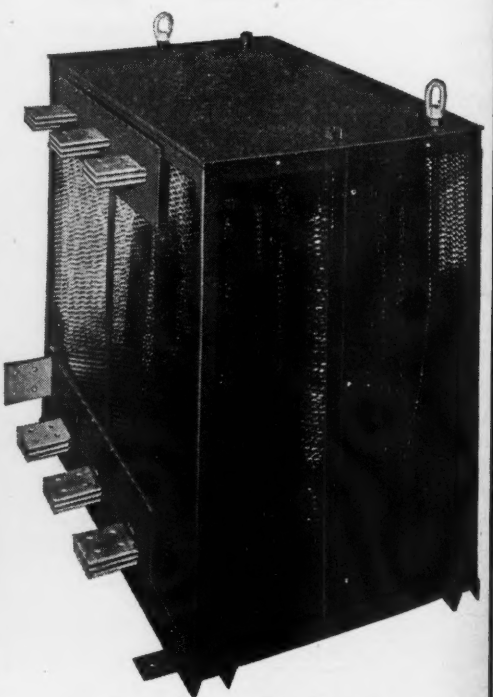
For interior high voltage distribution systems with transformers
at load centers. Sizes up to 1000 KVA. Voltages up to 13,200.



Special 4600 Volt
Electronic Transformer



500 KVA. 3-phase.
4160 Volt Transformer. For Indoor Sub-Stations.



Booster Auto Transformer
1000 KVA. 3-phase. 208/120 to 240 volt.

SORGEL ELECTRIC CO., 836 W. National Ave., MILWAUKEE 4, Wis.

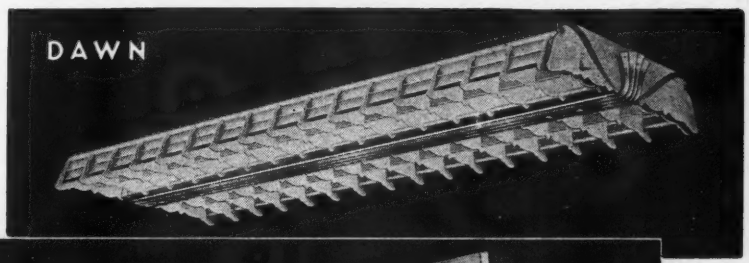
Pioneers in the development and manufacturing of Air-Cooled transformers.

Smithcraft – always a WINNING HAND

Outstanding beauty of design, efficiency of operation, soft ample illumination and low maintenance cost make *Smithcraft* FLUORESCENTS the leaders in their field

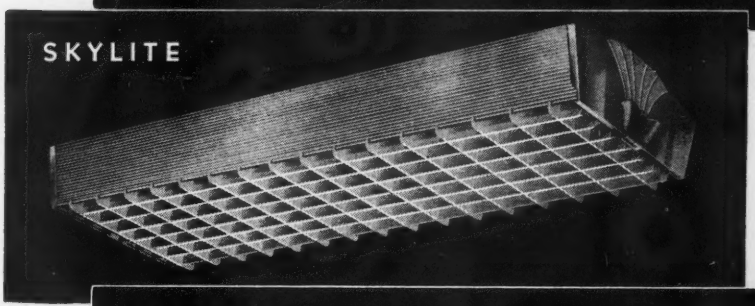
DISTINCTIVE LIGHTING with a strikingly new louver design. Graceful scalloped edges sweep upward at ends in decorative fingers which catch and diffuse light along fluted sides of housing.

DAWN



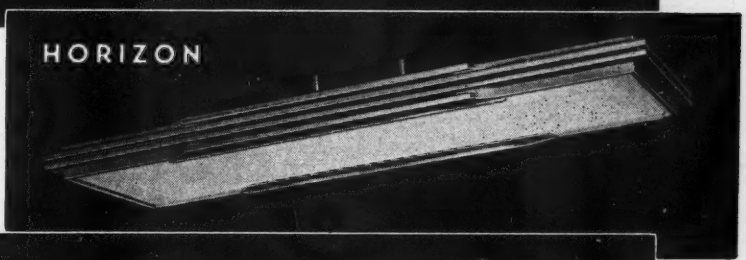
RIBBED GLASS side lights and smart, shallow, hinged louvers control low surface-brightness. Smithcraft-engineered housing with baked enamel parabolic reflectors provides increased down lighting. A beautiful, practical fixture.

SKYLITE



MODERNLY DESIGNED — gracefully slim. Natural wood frame with etched glass panel showing clear inline. Overall depth 2¾" when flush mounted. May be had with hinged louver. "Belongs" in types of interiors where no other fixture will quite do.

HORIZON



A PRACTICAL AND BEAUTIFUL open-type unit. Time-cutting features in hanging with Smithcraft one-man ceiling plate and Non-turn Stem Lock Canopy set, make it economical in single or continuous mounting. A very effective fixture where general overall light is desired.

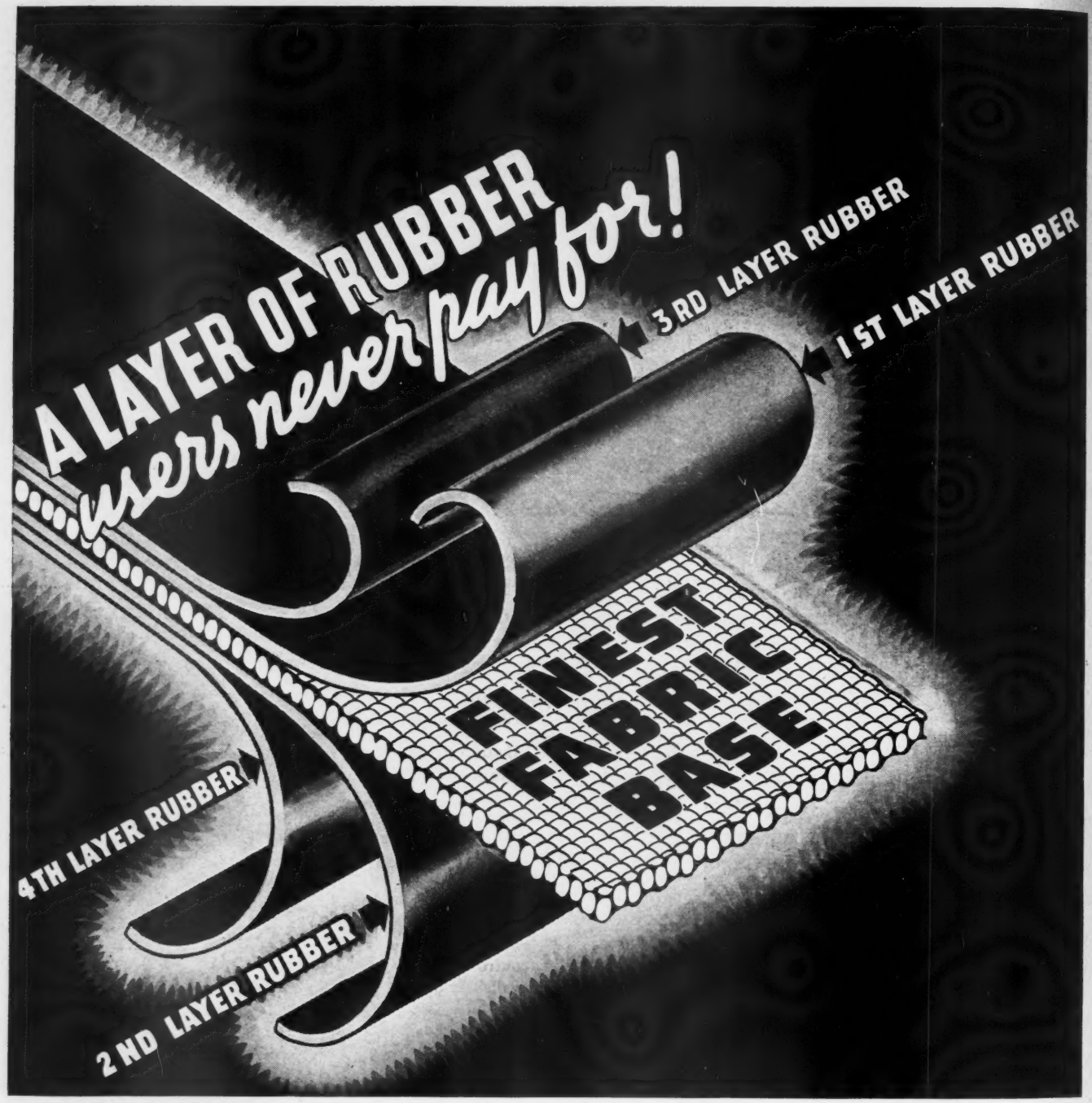
PEERLESS

Send for complete catalog of Smithcraft industrial and commercial fixtures

DISTRIBUTED THROUGH RECOGNIZED ELECTRICAL WHOLESALERS

A complete line of commercial and industrial **FLUORESCENT FIXTURES**

Smithcraft **LIGHTING DIVISION** Chelsea 50, Mass.



THE JUMBO PACKAGE

contains 10 standard No. 8 rolls, the economical way for electrical contractors, repairman and industrial users to purchase Friction Tape where individually cartoned tape is not required. Tape in individual cartons is available in sizes 8, 4, 2 and 1.

This is the way a piece of DUTCH BRAND Friction Tape would look if magnified and separated into its parts. An extra layer of live, tacky compound in every inch of tape. Extra insulation . . . extra wear . . . extra value . . . no wonder Dutch Brand has gained its reputation as the "Extra Service" friction tape. Specify Dutch Brand on your next job.

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MANUFACTURERS OF **DUTCH BRAND** RUBBER INSULATING TAPE,
ELECTRO COIL TAPE, INDUSTRIAL GRAY FRICTION TAPE AND GLASS FIBRE TAPE

CHICAGO 19, U. S. A.

One Man--- One Minute...

Thats All it Takes to Bleed

Wagner

Hydraulic Industrial Braking Systems

Remote-control bleeding is the latest improvement in Wagner hydraulic braking systems for overhead traveling cranes and other industrial equipment. Controlled from the crane cab, the bleeder enables the operator to remove air from the fluid lines whenever necessary, simply by pressing a pushbutton and pumping the control cylinder foot pedal.

Other Advantages of the Remote-Control Bleeder:

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2. Maximum braking efficiency is constantly maintained by keeping lines full of fluid at all times.

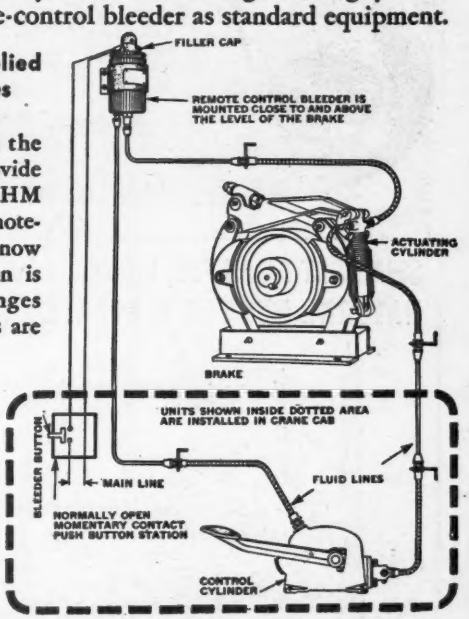
3. Circulatory bleeding results in a saving of fluid, since none is lost during the bleeding operation.

4. Brake can be installed at a considerable height above the control cylinder—an important factor in successful ladle crane applications.

All current Wagner Hydraulic crane-bridge braking systems include the remote-control bleeder as standard equipment.

Can Be Easily Applied to Wagner Brakes Now In Service.

Kits containing all the parts needed to provide type H and type HM brakes with the remote-control bleeder are now available. Installation is simple, as no changes in the basic systems are necessary.



In addition to these important features furnished by the remote-control bleeder, Wagner hydraulic industrial brakes offer many other advantages, discussed in Bulletin IU-186. Send for a copy today, addressing your request to Wagner Electric Corporation, 6413 Plymouth Avenue, St. Louis 14, Mo.

Consult Wagner Engineers on all Industrial Braking Problems

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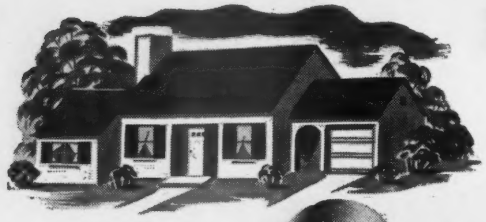
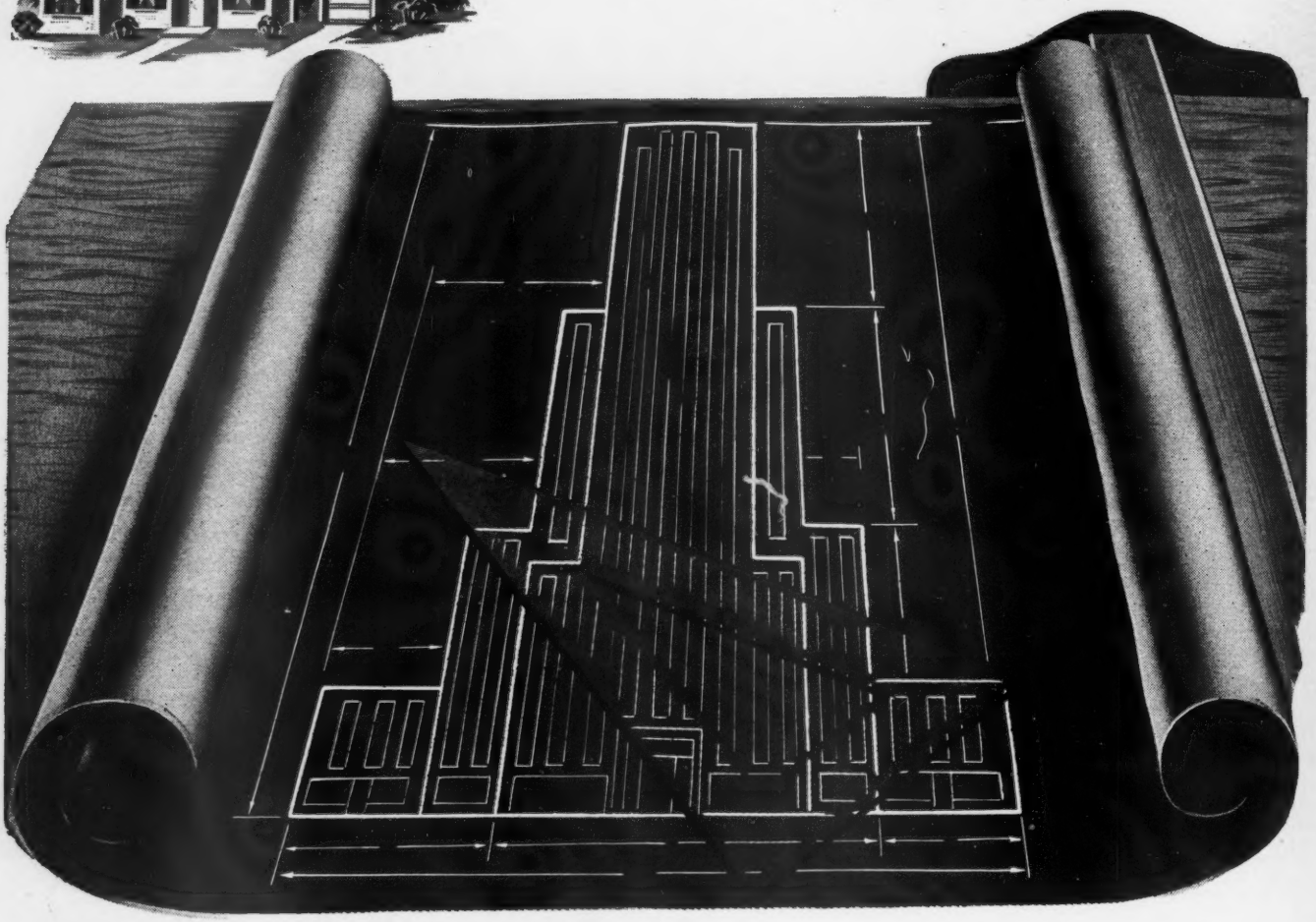


BUNGALOW OR BIG BUILDING

HERE'S THE QUESTION...



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← **SAFER** because of perfectly centered conductors.

← **SAFER** because 10 layers of pure rubber insulation guard against current leakage.

← **SAFER** because of special fibrous, flame-resistant cover.

Smaller size permits more circuits in conduit.

U.S. Laytex CONSTRUCTION

RU wiring with RU?

You're on the right track for adequate wiring—for new structures or old—if the specifications read "RU-Laytex".

For RU-Laytex, with its unique laminated insulation of purified natural rubber is today's lightest weight, smallest diameter, rubber insulated building wire.

Both in physical and electrical properties RU-Laytex leads the field. It prevents current leakage, has greater resistance to climatic deterioration, is easier to install, permits more circuits in a given space.

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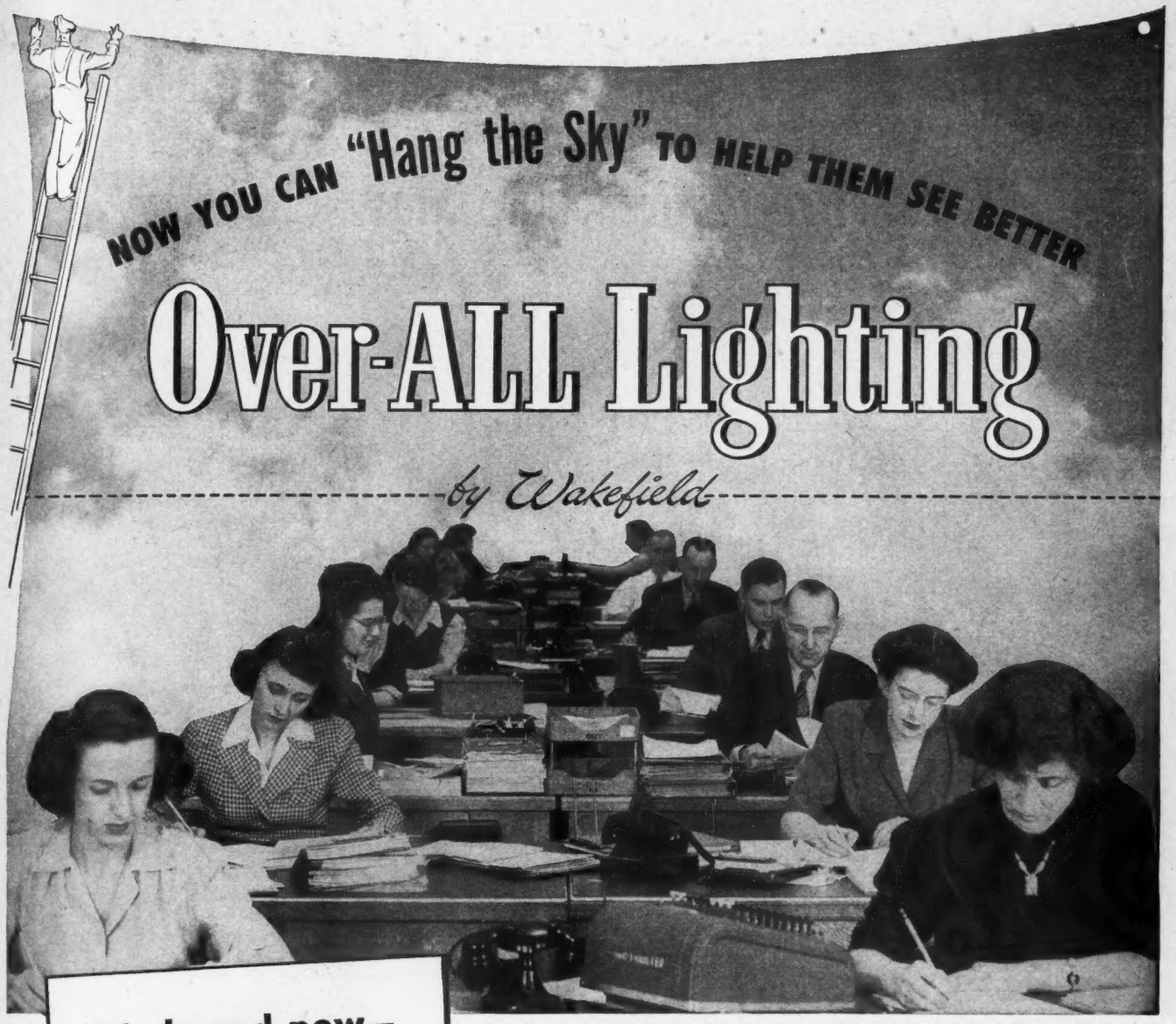

It's brand new— The STAR

Here's the answer for many of your needs. Provides all the advantages of both fluorescent and indirect light plus simple, sturdy construction and easy maintenance. Checked and improved by pre-testing. Unusually simple to handle and clean—just slide out Plaskon reflector section. No need to take unit apart. Ideal for office, drafting room or school. Plan for it on your next job.

It's new — THE WAKEFIELD STAR

BOOST YOUR SALES with a new approach to office lighting

Over-ALL Lighting by Wakefield provides a new method for lighting office interiors and for lighting drafting rooms and schools. A method that makes for easier seeing *and for more business for you!*

Designed to protect eyes against strain, the new Wakefield Over-ALL Lighting method spreads soft pleasing light *over all.* Your customers will like it because this new system is based on lighting results which mean comfort plus efficiency.

And especially important to you—Wakefield equipment for Over-ALL lighting has been designed to simplify your work . . . through easy installation, easy maintenance and long-lasting service *in addition to top lighting performance.*

Ask your Wakefield distributor to tell you how Over-ALL Lighting can work for you. The F. W. Wakefield Brass Company, Vermilion, Ohio.

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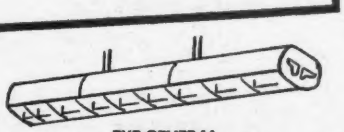
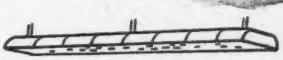


THE GENERAL



THE GRENADIER

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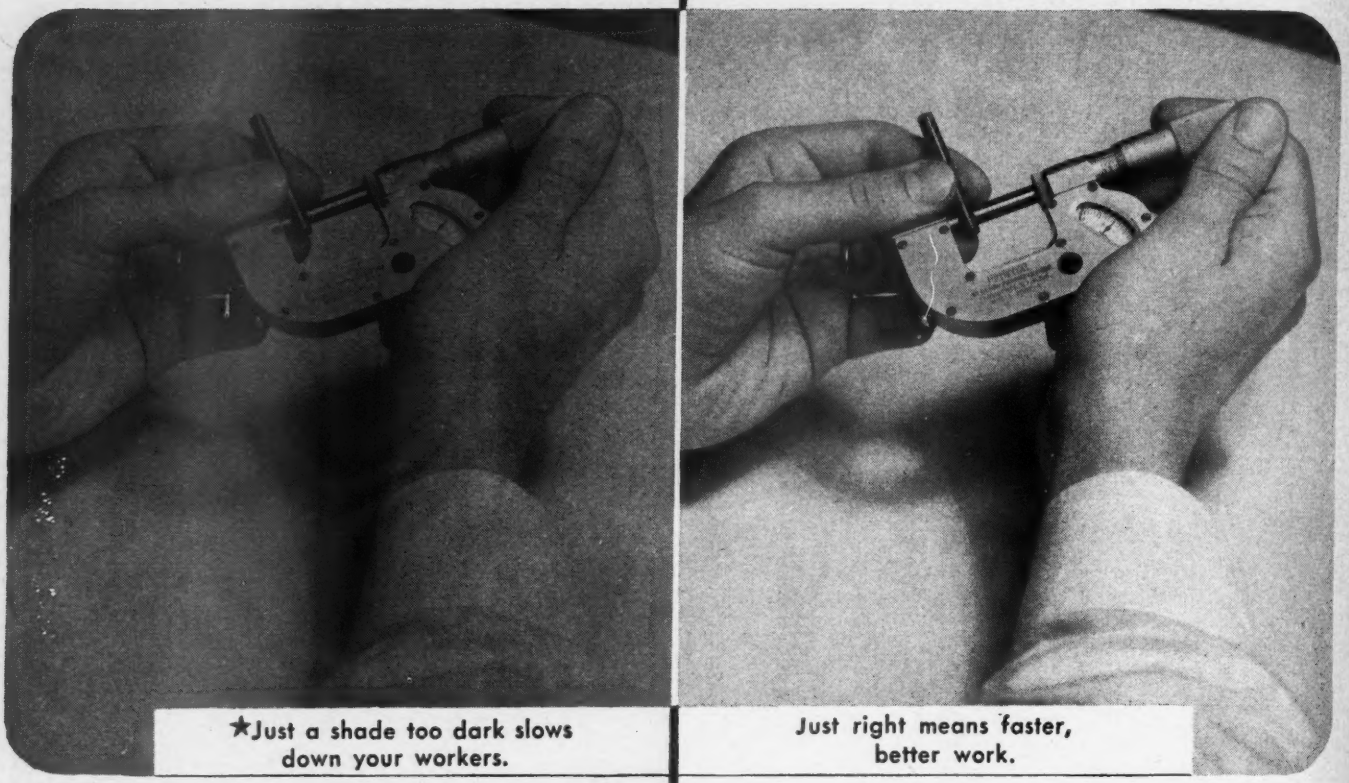
BORDERLINE VISION*

Means Production Line Slow-Downs



*Just a shade too dark slows down your workers.

Just right means faster, better work.

For Faster, Better Work Install Wheeler Skilled Lighting!

Borderline Vision is hard to spot at a glance. But watch out...

Every time a worker in your plant has to stop for a second look – you lose money! Every time he fails to stop and the work is wrong – you lose money!

Lighting just a shade too dark causes little slow-downs that add up to an expensive lag in production.

For 65 years Wheeler has specialized in light engineering that eliminates lighting handicaps. Wheeler Reflectors are engineered to *control* light. Their special, high reflection factor gets maximum illumination from standard lamps. And their rugged, porcelain, enamel-coated construction means long service and easy maintenance.

Better work and reduced costs are almost automatic when you install Wheeler Skilled Lighting. Learn why! Write today for facts on the full line of Wheeler incandescent and fluorescent lighting fixtures. **Wheeler Reflector Company, 275 Congress St., Boston 10, Mass.** Representatives in New York and principal cities.

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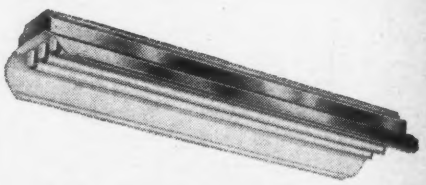
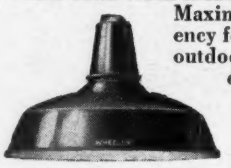


All-Steel Open-End Fluorescent Unit
Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Mounts from chain or conduit, individually or in continuous runs.

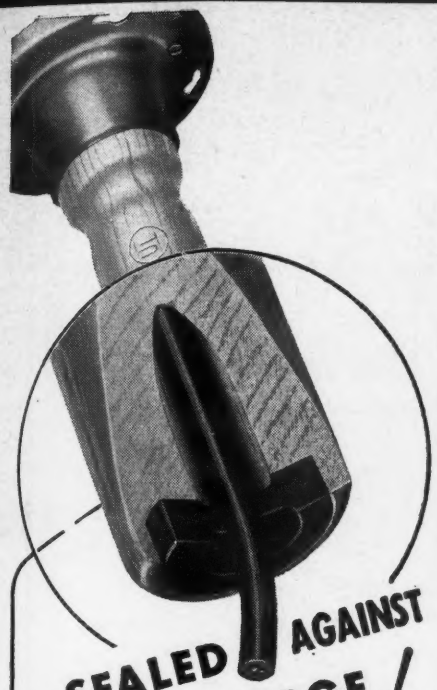
RLM Solid Neck Incandescent Reflector
Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.



Wheeler Reflectors

SKILLED LIGHTING

MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881



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McGILL LAMP GUARD HANDLES

No. 4675

No. 8000

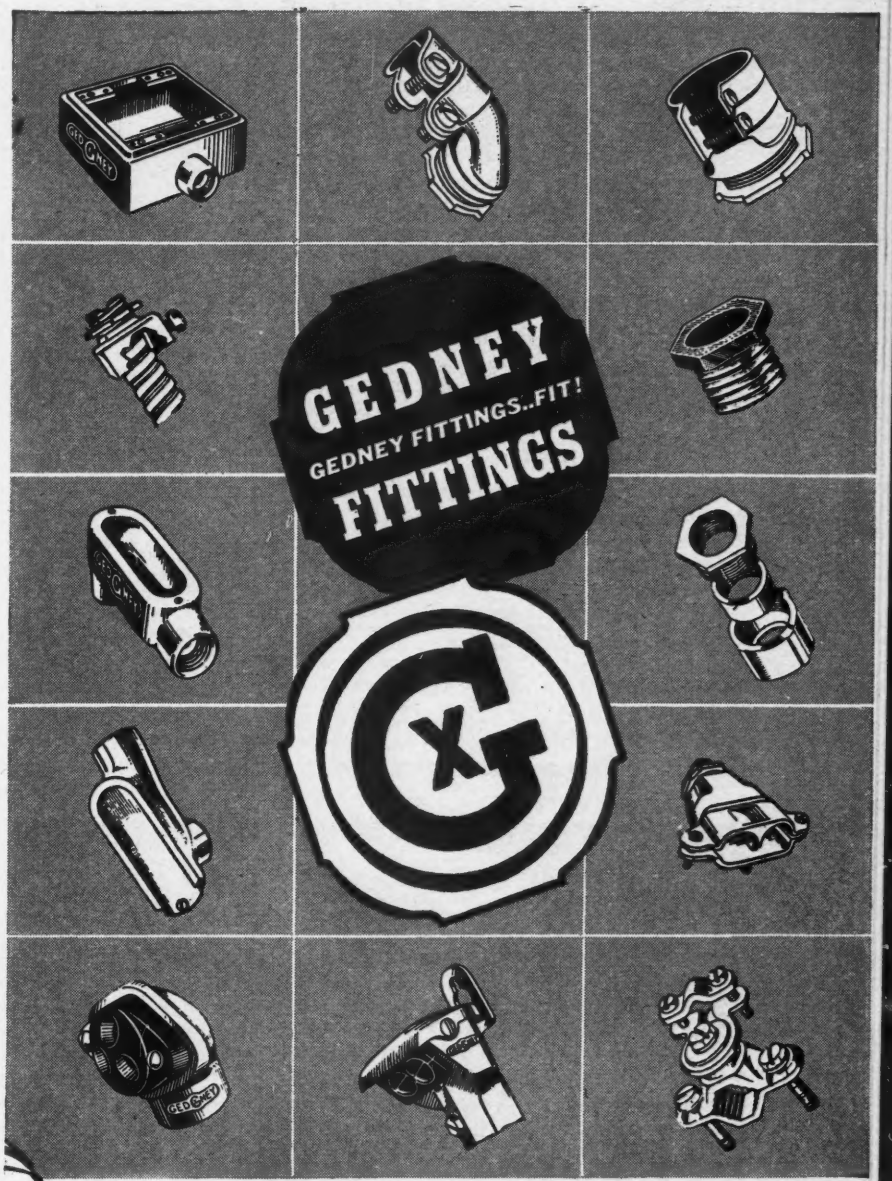
A live red rubber gasket, solidly cemented into the end of the handle adds still another safety feature to all McGill wood-handle Lamp Guards. Flexible, yet firm, the rubber gasket grips the cord closely as it enters the handle. The snug fit makes a moisture-proof seal which positively bars dangerous water seepage . . . holds the cord away from the sides of the channel, preventing the cord-fray which means shorts and shocks. There are more than seventy portable wood-handle lamp guard types in the comprehensive McGill line . . . all of them designed for maximum safety. Other safety and convenience features include handy thumb switch, cage heavily plated to prevent corrosion, Levolier socket and sturdy hardwood handle. Write direct or ask your wholesaler for more information on "Safety-First" McGill Lamp Guards . . . for every lamp use in industry.

Electrical Division

McGILL

MANUFACTURING CO., INC.
VALPARAISO, INDIANA

Easily Installed . .
. . Because They Fit!



A complete line of fittings...

Depend on GEDNEY fittings to help you do a better job with no loss of time due to poor finish. Every fitting marked with the GEDNEY trademark is smooth finished and thoroughly inspected before leaving the factory. This quality control is the reason contractors rely on GEDNEY—because they go up fast and make a good, clean job all along the line.

All GEDNEY fittings are made of highest grade malleable iron, finished smooth and rust-proofed. Packed in convenient quantities in metal edge cartons and each carton is clearly labeled. Approved by Underwriters' Laboratories. Your wholesaler has them, now!

GET YOUR COPY TODAY—The new completely illustrated GEDNEY Catalog gives full data on the entire line of conduit bodies and fittings, entrance fittings, armored and non-metalic cable fittings, etc. Please write on your company letterhead.

LOOK FOR THIS MARK
It is the publicized assurance of dependable fittings for faster installation because GEDNEY Fittings . . . Fit!

GEDNEY ELECTRIC COMPANY

Factory, Foundry and Shipping Point: Terryville, Conn.
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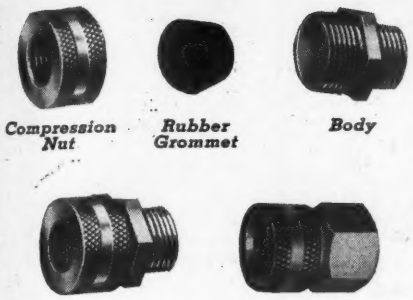
Portable Cord and Cable Grips



Cord and cable grips for portable wiring offer a complete line of substantially built fittings for heavy duty service. The standard types shown have aluminum body, aluminum compression nut, and single hole rubber grommet. Two and three hole grommets can be furnished.

Angle types are available; also female bodies with or without chase nipples; also with serrated body for mounting in sheet metal panels or cabinets.

Compression nuts with split clamp, with hose attachment, with extended handle, or with cord protecting spring are available. A coupling for flexible conduit can be supplied.

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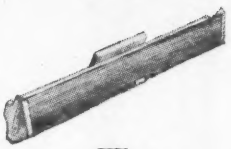
OAMCO REFLECTORS


3060


3084


3050A


3073


1195


1139


1134


885


871

OAMCO FLUORESCENT LAMP FIXTURES

- No. 3060 is a 2-lamp 40-watt Heavy Duty Industrial Fixture. No. 3061 in this series is a 3-lamp 40-watt type and No. 3062 a 2-lamp 100 watt type. Available in porcelain enamel or synthetic enamel. Made as individual fixtures or for continuous rows.
- No. 3084 is a 2-lamp 40-watt glass enclosed kitchen unit. For either suspension or ceiling mounting.
- No. 3050A is a 4-lamp 40-watt commercial unit for suspension mounting. No. 3051 in this series is a 4-lamp 40-watt fixture for ceiling mounting.

No. 3050 is a 2-lamp 40-watt unit for suspension mounting.

- No. 3073 is a 4-lamp 40-watt egg crate louver commercial fixture for suspension mounting. No. 3074 in this series is a 4-lamp 40-watt type for ceiling mounting.

INDUSTRIAL AND COMMERCIAL LIGHTING

- Weatherproof Bracket Fixtures (Yard-lights) No. 1195 series come equipped with either 12 or 14" reflector. Listed by Underwriters' Laboratories, Inc., and approved by R.E.A.
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- Vaportight Fixtures No. 1134 series listed by Underwriters' Laboratories, Inc. Available with or without guard. Tapped for ½" conduit or without outlet box cover.
- Heavy Duty RLM Threaded Dome Reflectors No. 1056 series, with pendent hood or outlet box hood.
- RLM Standard Dome Reflectors No. 885 series, made for 100, 150, 200, 300 and 500 watt lamp sizes.
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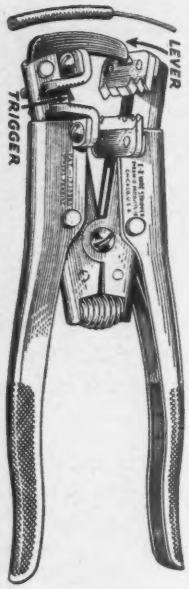
RIGHT LIGHT SINCE 1902
Member of the RLM Standards Institute

E-Z WIRE STRIPPERS

ALL STEEL



Automatic Model
Stranded and
Solid Wires
$4.80

Simple and efficient. As easy to operate as a pair of pliers. Its triplicate action of clamping the wire, cutting the insulation and stripping is automatically timed and performed with ONE squeeze of the handles.

The AUTOMATIC type featuring the lever prevents crushing stranded wire.

Available for wires from No. 8 to No. 30 gauge. NEW! No. 02 for 10 to 22 ga.

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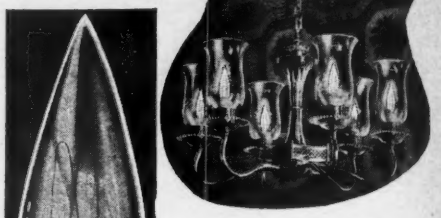
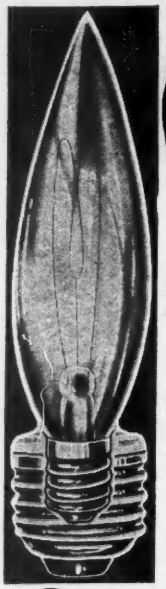
Candylbeme Lamps

Beautify Fixtures And Increase Bulb Sales





The full, sparkling beauty of candelabra, crystal and polished fixtures is effectively brought out by Candylbeme Lamps. Lighted or unlighted, they add charming realism to all candle type fixtures. Increase your fixture sales as well as your bulb sales by featuring Candylbeme Lamps.

Candylbeme Lamps are available now for prompt delivery. Illustrated bulletins with details and prices sent upon request. *Nationally Advertised!*

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NORTH AMERICAN *Electric Lamp Co.*

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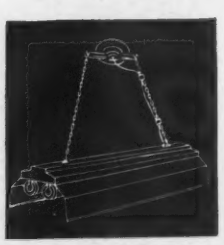
360° Adjustment

NEW "*Friction-Set*" FIXTURE HANGER . . .

That Adjust With a Twist of the Wrist!

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3¼" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.

Friction-Set K100 . . . List Price $1.10



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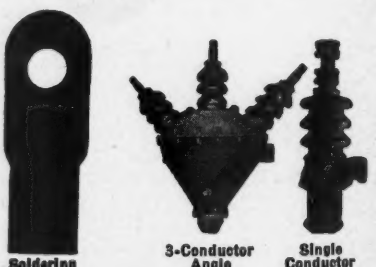

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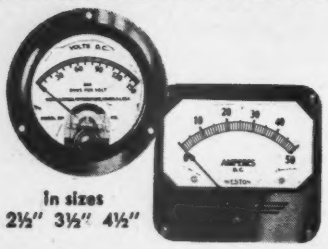
PANEL and PORTABLE INSTRUMENTS



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WESTON offers a complete line of instruments for all panel requirements, including DC, AC power frequencies and radio frequency, Rectifier types and DB meters. For any panel or switchboard requirement, consult the nearest **WESTON** representative.

Model 430

Compact, rugged portable test instruments, with large openings for good visibility of the long, hand calibrated mirror scales. Available as AC or DC Voltmeters, Ammeters, Milliammeters, DC Microammeters, AC Rectifier type Millivoltmeters and DC and single phase AC Wattmeters.

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Highly sensitive instruments of the double pivoted type not requiring leveling. Magnetically and statically shielded. Available as multi range DC Voltmeters, Millivoltmeters, Milliammeters, Microammeters and Electrolysis Volt-Millivoltmeters, and AC Thermo Ammeters, Thermo Milliammeters and Thermo Voltmeters.

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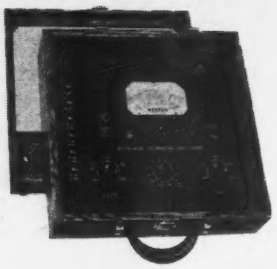

Model 785
Industrial
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Provides 27 carefully selected AC and DC voltage and current, and resistance ranges. DC sensitivity 20,000 ohms per volt. Ideal for electronic testing and maintenance requirements. Other built-up testers also.

Model 564
Volt-Ohmmeter

Model 697
Volt-Ohm-Milliammeter

A line of pocket-size test instruments including Ohmmeters, Volt-Ohmmeters, Volt-Ohm-Milliammeters, Power Level Meters, and Insulation Testers. Ideal for bench testing, inspection, field servicing.

PHOTO-ELECTRIC CELLS and DEVICES

Model 703
Sight Meter

Model 594
Photronic Cell

WESTON Photronic Cells combine practical stability with high sensitivity and reduced fatigue. Respond to wave lengths from ultra-violet to infra-red, and can be matched for spectral sensitivity, linearity, etc. In conventional types and cases, or unmounted in various shapes and sizes.

WESTON Illumination Meters are available in types for all requirements, and VISCOR filtered to give direct measurements of the illumination from any source regardless of color composition.

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Model 613
Time Delay Relay

Model 705 Sensitrol Relay combines high sensitivity and high contact capacity. Positive operation on values as low as 1 microamperes or 1 millivolt d-c, or 10 microamperes a-c. Magnetic contact principle assures perfect contact and eliminates chattering. Also time delay and power relays designed to operate from **WESTON** sensitive relay contacts, providing complete control sequence.

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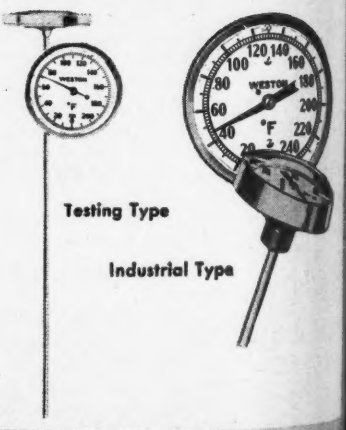

Testing Type

Industrial Type

Large, gauge-type scales provide extreme legibility. Simple, all-metal construction (no gases or liquids used) provides unusual ruggedness and assures dependable readings. Unaffected by occasional over-temperatures. Available in testing type and industrial types with head diameters of 3", 5" and 6". Stem lengths 2½" to 24" and longer. Ranges from −100°F to +1000°F.

How to Maintain Fluorescent Lamps

First of two articles giving practical suggestions on preventive and scheduled maintenance of fluorescent lighting equipment.

By Harris Reinhardt
Sylvania Electric Products, Inc.
Salem, Massachusetts

To get maximum lighting efficiency at minimum cost, it is necessary to maintain and conserve fluorescent lighting equipment. An *ounce of prevention,* or preventive maintenance, is worth a *pound of cure,* or repairs of breakdowns and defects due to neglect.

The average fluorescent lighting system is not properly maintained. This may be due, in part, to the indifferent attitude developed toward maintenance of incandescent lighting systems. In these, the circuits are simple, and a cleaning and lamp replacement schedule usually comprise the total maintenance.

Fluorescent lighting circuits are more complicated. They involve electronics in a simple way. Knowledge of how to spot danger signals, how to estimate replacements, what factors affect lighting performance, and similar information will greatly aid in keeping fluorescent equipment at peak efficiency. This article outlines simple steps in preventive lamp maintenance, shows what to look for when faults occur, and tells how to remedy defects that may be causing improper performance.

One of the first steps in lamp maintenance is to know how to properly install or remove a fluorescent lamp. It is a simple task, yet much lamp trouble develops as a result of carelessness in installing them. The two contact pins at each end of a lamp should be slipped into the slots provided in the lampholder, and the lamp should then be given a quarter turn—in either direction. Tension of spring contacts in the lampholders make it easy to tell when a lamp is in place, and care should be exercised to be sure the lamp is properly seated. Lamps can be removed easily, by rotating a quarter turn, in either direction.

Knowledge of average rated life of a fluorescent lamp, and how it is determined, is important (Fig. 1). It will aid in establishing a lamp replacement schedule, and in analyzing proper electrical operation.

Lamp life depends to some extent not only upon the number of hours a lamp is operated, but also on the number of times the lamp is turned on and off. In tests which have been conducted to determine life expectancy of lamps, the lamps were turned off at either 3, 6 or 12 hour intervals. In actual business and industrial use, lamps are usually left burning for periods which approximate these values. Average life ratings shown in Table I, covering standard size lamps, are the results of such tests. The number of hours per start and the average rated life are determined by constantly testing hundreds of lamps under laboratory controlled conditions in which voltage and other factors are kept uniform.

The normal life expectancy, or average rated life, of a 40-watt fluorescent lamp with three burning hours per start is 2500 hours. This information makes it possible to esti-

TABLE I

AVERAGE RATED LIFE FOR FLUORESCENT LAMPS

Size Lamp	Burning Hours Per Start		
(Watts)	3	6	12
15 to 40	2500	4000	6000
100	3000	4500	6500

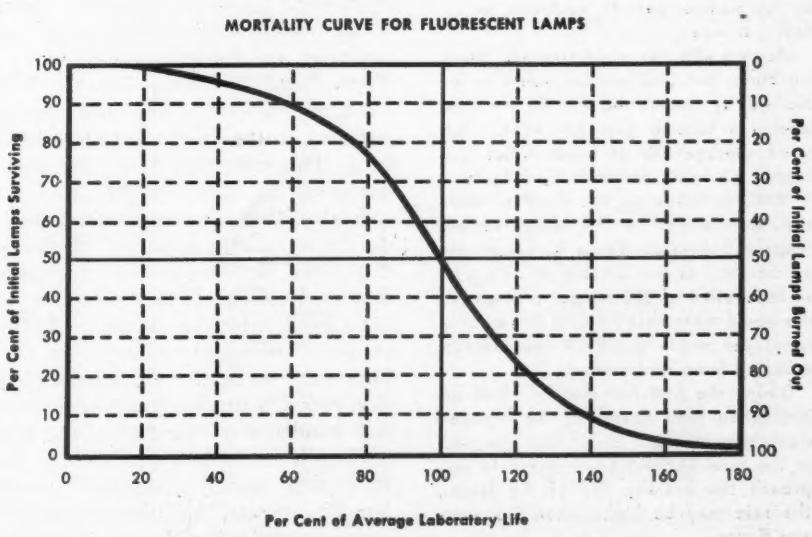

FIG. 1—Mortality curve for fluorescent lamps.

mate with reasonable accuracy the average number of replacements which may be expected during a given period of time.

Using life expectancy figures shown in Table I, a chart has been prepared to simplify figuring the estimated lamp

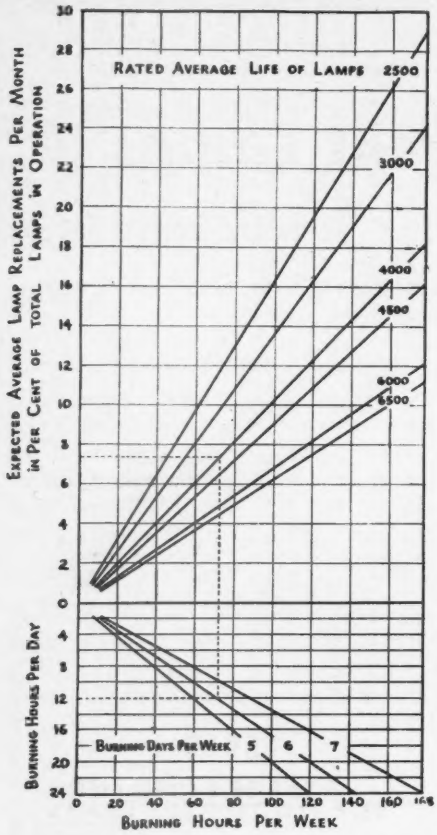

FIG. 2—Chart for estimating lamp replacements.

HOW TO USE CHART FOR ESTIMATING LAMP REPLACEMENTS

As an example of the use of this chart, suppose that an installation consisting of 200 - 40 watt fluorescent lamps is burned for two six-hour periods, each day for six days per week.

Starting with the scale labeled "Burning Hours per Day" follow across as indicated by the dotted line to the line labeled 6 burning days per week. The rated average life of lamps which are burned six hours per start from Table I is 4000, so follow up the chart to 4000 and then across to the scale labeled "Expected Average Lamp Replacements per Month," to find a value of 7.8%. In an installation of 200 lamps, as assumed, this would mean that 7.8% of 200 or 15.6 lamps per month would be the average expected lamp replacements.

During the first few months which an installation is in operation, the replacements may be much lower than this, and as the total burning hours begin to approach the average life of the lamps, the rate may be higher than the average figure.

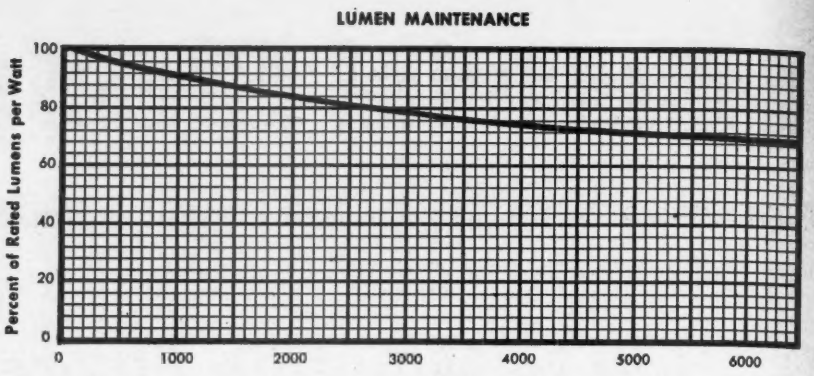

FIG. 3—Normal decrease in light output for a fluorescent lamp during its rated life.

replacements per month (Fig. 2). It is only necessary to know the total number and type of lamps in an installation, and the average burning hours, in order to use this chart.

There is a normal decrease in the light output of a fluorescent lamp during its rated life. The rated initial lumen values for fluorescent lamps (Fig. 3) are based on measurements made on lamps which have been burned for 100 hours. The actual initial values when new lamps are first placed in service may be as much as 10 percent greater than shown. The average light output during the remaining hours of the lamp life is approximately 83 percent of the value at 100 hours.

There are six factors which affect the performance and life of fluorescent lamps. They are:

1. Total hours of operation
2. Number of times lamps are started
3. Performance characteristic of the starter and ballast
4. Voltage variation
5. Temperature conditions
6. Vibration

Visual inspection will show how fluorescent lamps are operating. Some of the more visible effects, and their meaning, are discussed below.

Normal end darkening—Intense darkening at the end of the tube directly adjacent to the base occurs late in its life. This corresponds to the blackening of an incandescent lamp. It indicates that the emissive material on the electrodes is nearly exhausted.

Early end darkening—End darkening very early in life (Fig. 4) may be due to: (1) a defective starter; (2) improperly designed ballast; or (3) improper voltage. Occasionally, in new lamps, a small amount of mercury will condense on the end of the tube, giving it a dark appearance. This darkening rapidly disappears as the lamp is operated and the mercury becomes vaporized, although it may re-

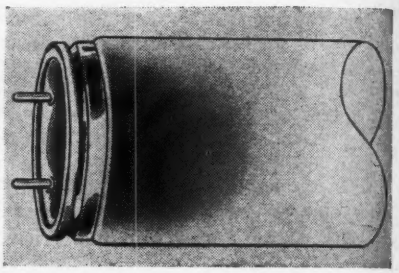

FIG. 4—End darkening can be normal, or a sign of improper operation.

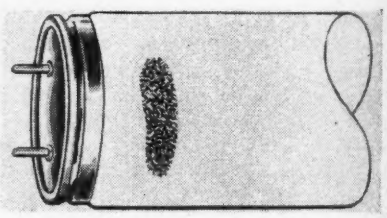

FIG. 5—Cathode spots appear near the cathode, and may extend nearly halfway around tube.

appear, generally in the coolest spot on the tube.

Mercury streaks along tube—While the amount of mercury required to give good lamp performance is very accurately controlled, a portion of this mercury may not vaporize under certain operating conditions. As a result, it will collect at the coolest part of the lamp. Since the lower portion of a lamp burned horizontally is normally the coolest, this mercury condensation appears as a dark streak along the bottom of the lamp, sometimes extending for several inches. If a cold object is allowed to touch a part of the tube, or any portion of the tube is cooler than the remainder, due to a draft or for any other reason, the mercury will condense and become visible at this point. Lamps should not be discarded simply because they have mercury streaks of this kind. The mercury vaporized is adequate for proper lamp performance.

Discoloration bands or rings—Brownish discoloration bands or rings occa-

sionally appear about two inches from the end of the lamp, cut off rather sharply on the side nearest the base. Since they usually cover a small percentage of the total tube area, and as a rule are not intense, they cause very little loss of light output.

Dense spots near ends of lamps—Occasionally, dark spots appear at a point directly opposite or near the cathode (cathode spots), about an inch from the base (Fig. 5). These spots vary in size and, in extreme cases, may extend nearly half way around the tube. Being near the end of the lamp, they do not cause any measurable loss of light or change the operating characteristics of the lamp.

The normal failure of fluorescent lamps are easily recognized. Some of the more prominent symptoms of normal failure are outlined below.

The electron-emissive material on the cathodes of a fluorescent lamp is gradually used up during operation until it is no longer possible to establish the arc in the lamp. As the starter continues in its efforts to start the lamp, the glow at one end of the lamp will become abnormally orange-red, and there will be a flash of the lamp trying to start as the starter opens. But because the arc is either not established at all, or is very unstable, a "shimmering" effect may be noticed during the short time the lamp remains lighted. Normal end darkening probably will be noticed, too. Such lamps should be replaced as soon as possible.

If the lamp is not removed, the starter will continue in its efforts to start the lamp until the starter itself fails. Use of a cut-out type of starter will limit this effort to a few attempts only, thereby saving the starter, and possibly the ballast.

When an incandescent lamp fails to light in a live socket, it is assumed that the lamp is burned out, and it is replaced. There is a natural tendency to follow the same procedure with fluorescent lamps.

However, when a fluorescent lamp fails to light, it may be due to either a faulty starter, an open circuit in the fixture wiring, or a defect in the ballast. Thus it is advisable to check these points, or the lamps may be replaced unnecessarily.

In some instances, an examination of burned-out lamps will be helpful in arriving at the cause of early failure or unsatisfactory performance. However, a lamp which has been burned under abnormal conditions may show every sign of normal failure, so that an examination of the lamp should be supplemented by careful check on

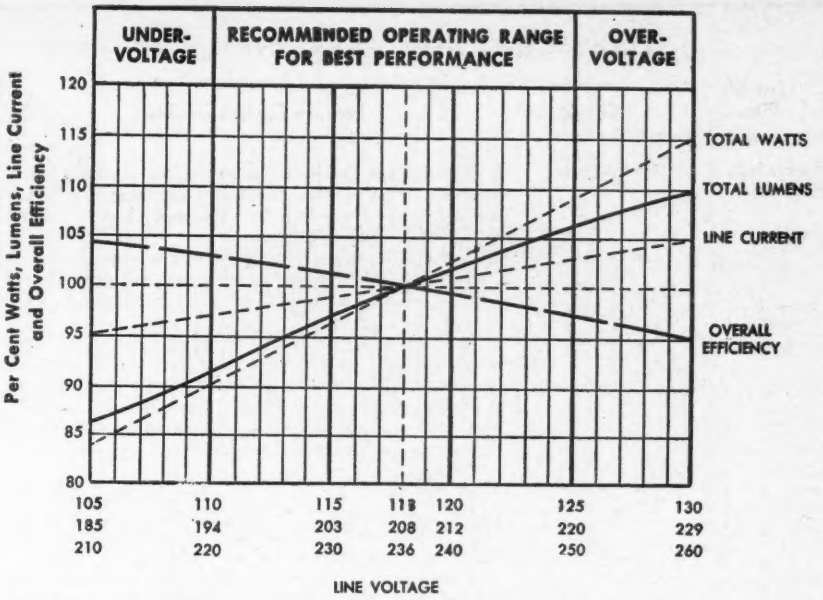

FIG. 6—Chart shows effect of line voltage on fluorescent lamp performance.

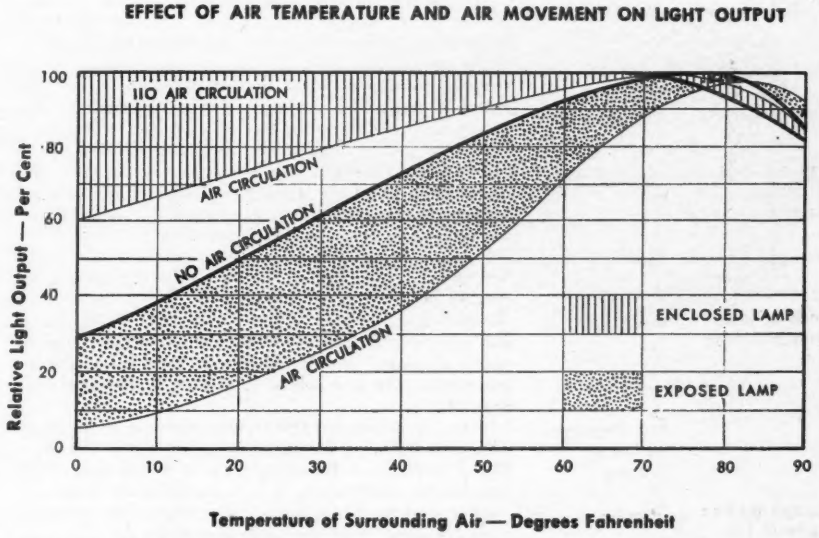

FIG. 7—Chart shows how fluorescent lamps perform at various temperatures.

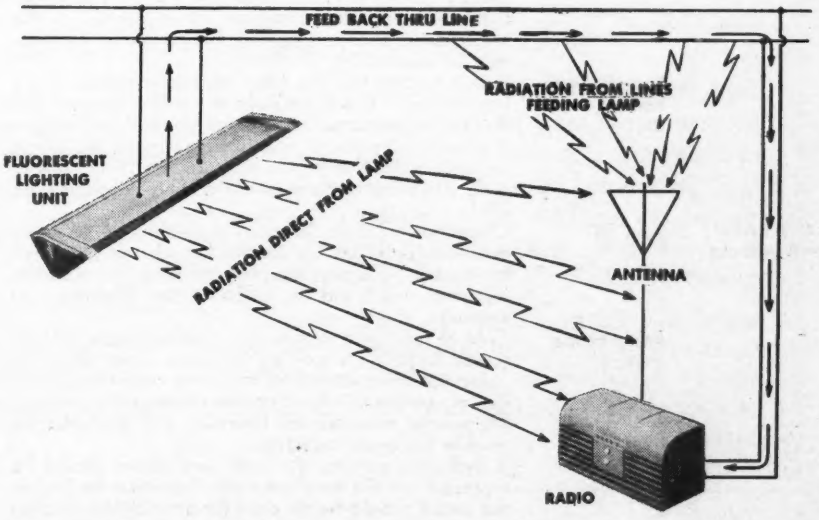

FIG. 8—Some possible causes of radio interference from fluorescent lamps.

FLUORESCENT LAMP CHECK CHART

Trouble Signal	Check	How to Correct Trouble
Lamp fails to light	Connections	It is important to check carefully the electrical connections to be sure that current is available. If this is done, but the lamp fails to light, one or more of the following tests should be made.
	Lamp	Make sure the lamp is not defective by checking it in a fixture which is known to be operating properly, or replace it with a lamp which has been checked and is known to be good.
	Starter	If the lamp which is known to be good will not light in the fixture, remove the starter from the fixture and replace it with a starter which has been checked and is known to be good. If the lamp will not light with this starter, it indicates that something is wrong with the wiring in the ballast, or that there is poor contact in the sockets.
	For poor contact	Twist the lamp gently in the lampholders with the current turned on to see if proper contact can be made. The connection of the lead wires at the lampholder should also be checked to see that they are tight.
	Ballast	If a check on all the above does not disclose a defective part, the ballast is probably the source of trouble and should be replaced.
Lamp blinks or flashes on and off	Lamp	The blinking of a lamp may be caused by normal lamp failure in which case the ends will be darkened and the preheating glow will be distinctly reddish. Either the arc is not established, or it is characterized by a shimmering effect during the short time the lamp remains lighted.
	Starter	Remove the starter while the lamp is lighted. If the blinking stops, the starter is either defective or the wrong size. The trouble may also be due to improper line voltage or an improperly designed ballast.
Lamp blinks or flashes on and off	For improper wiring	In a two lamp ballast, it is possible to criss-cross the lead wires so that the lamp may flash continuously for a long time before lighting. Check the wiring diagram which appears on the ballast label.
	Ballast	If a check on all the above does not disclose a defective part, the ballast is probably the source of trouble and should be replaced.
Ends of lamp remain lighted	Starter	A short circuit in the starter is the most likely cause. This can be checked easily by removing the starter to see if the lamp will light without it or by replacing the starter with one which is known to be operating properly.
	For improper wiring or ground	It is also possible that the trouble may be in incorrect wiring or a ground in the wiring or ballast. The most likely place for a ground to occur is at one end of the lampholder, particularly if it is mounted on metal.
Lamps darken early in life	Starting	Proper starting is necessary to conserve the electron emissive material on the lamp electrodes.
	Voltage	All fluorescent lamps are designed to operate at greatest efficiency within a specified voltage range. If the voltage is too low, too slow or flickering, cold starting results and the lamp life will be shortened. If the voltage is too high, the active material of the electrodes is used too rapidly and the life of the lamp may be appreciably shortened.
	Lampholder contact	It is important that the lamp be firmly seated in the lampholder. This is not only as a safety measure, but the arcing produced at a loose contact (particularly if vibration is present) may cause a serious loss of the emissive material from the electrodes. This results in early darkening at the ends of the lamp and short lamp life.
Lamp flicker, swirl or snake	Turn off	Occasionally, slight flickering or swirling appears in a new lamp but clears up after the lamp has been burned for a while. Turning the lamp off for a few moments frequently will aid in stopping the flickering or swirling.
	For improper starting	Cold or too rapid starting is a common cause of continued flickering or swirling in lamps. Even when the cause has been corrected, the lamp may continue to flicker, because it has become permanently injured. Frequently, however, the flickering will stop after the trouble has been corrected.
	Replace lamp	If flickering persists, the lamp and starter should be replaced. If the new lamp also continues to flicker, the circuit should be checked for poor ballast or other improper operating conditions.

the operating conditions wherever possible.

In burned-out lamps, each lamp, before it is discarded, should be tried in a fixture which is known to be operating properly, to determine whether it is the lamp or some other part which is wrong. Other possibilities which may cause the average lamp life to appear to be too short are as follows:

Performance not judged on average life basis
Lamp started too frequently
Improper starting
Improper ballast equipment
Improper voltage
Improper connections
Loose contact in lampholders
Improper surrounding temperature.

The "Fluorescent Lamp Check Chart" gives complete instructions for testing the various parts of the system if it is found that a lamp has burned out under abnormal conditions.

Within their normal operating range, fluorescent lamps are not as sensitive to voltage variations as incandescent lamps. However, if voltage is below normal operating ranges listed on auxiliaries, starting of the lamp becomes uncertain and there is a strain on the electrode material during the starting period which tends to shorten the life of the lamp. At voltages above the normal operating ranges, the emissive materials of the electrodes are used too rapidly, and the life of the lamp is also reduced. The effect of line voltage on fluorescent lamp performance is shown in Fig. 6.

A check of the voltage should be made at the time a lighting system is installed, and whenever new loads are put on the wiring system. This precaution is particularly important with fluorescent installations, since insufficient voltage not only lowers light output, but can shorten the life of the lamp and cause trouble in starting.

Fluorescent lamps are designed to give their best performance when the surrounding temperature is in the range of 60 to 90 degrees Fahrenheit (Fig. 7). At low temperatures the mercury in the lamp condenses, and the ultraviolet radiation is reduced, thereby lowering the light output of the lamp. At high temperatures the pressure of the mercury is increased, and as a result the ultraviolet radiations shift to longer wave lengths which are not so effective in producing fluorescent action. For an exposed lamp operating below 60 degrees Fahrenheit in a location where there is no draft, there is a drop of about one percent in relation to light output for each degree in the surrounding temperature. This loss may be even

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greater if the lamps are exposed to a draft or to air circulation.

If fluorescent lamps are to be used in an excessively low temperature, it is advisable to enclose the lamp so that it can build up its own envelope of heat each time it is lighted. For fluorescent lamps in use in an excessively high temperature, it may be advisable to provide ventilation around the lamp in order to keep the temperature at a moderate level.

Lampholders should be checked to be sure that connections are tight. The fastening assembly or hanging device should also be checked to see that this has not loosened thus causing additional vibration. If the vibration is still excessive, it may be necessary to use shock absorbing devices in the fixture hangers.

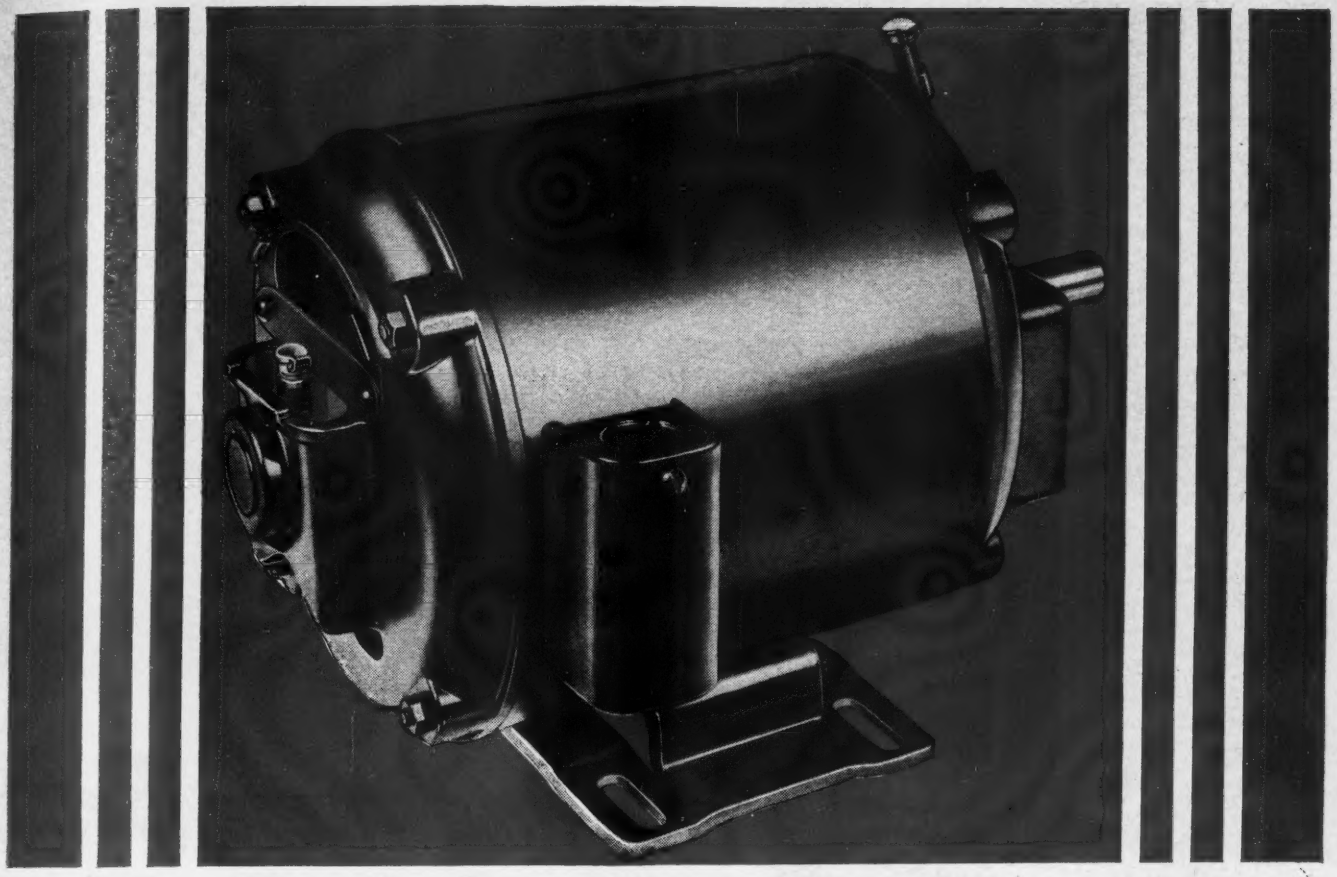
Objectionable humming, caused by magnetic forces within the ballast, usually may be remedied by checking the ballast mounting and attaching it to a rigid part of the fixture and by fastening all metallic parts securely, because loose screws or bolts increase humming. If the noise persists and is traced to a defective ballast, replace the ballast.

If a fluorescent lamp falls from a fixture, the spacing of lampholders should be checked to determine whether they are spaced in accordance with the published dimensions. The conditions of operation should be examined to see whether the fixtures are subject to very serious vibration or to heavy shocks, such as may be caused by heavy materials being dropped on the floor above the fixtures. Also, be sure that the lamps are being installed properly so that the base pins are firmly seated in the lampholder contacts.

Radio interference from fluorescent lamps arises from the fact that the arc within the lamp must be reestablished each time the voltage wave of the alternating current supply passes through zero, that is, 120 times per second on 60-cycle supply. Each time this arc is established, it results in the generation of energy in a form, which, under certain conditions, may give rise to radio interference.

If the lamps are properly installed and used with high quality auxiliary equipment, only a very small percentage will cause objectionable radio noise.

By proper installation is meant that the auxiliary equipment should be enclosed in a steel channel, the wiring should be made up with tight connections, the lamps and starters should be firmly installed in the sockets, and the fixture preferably should be grounded. Some of the possible causes of radio interference from fluorescent lamps are shown in Fig. 8.



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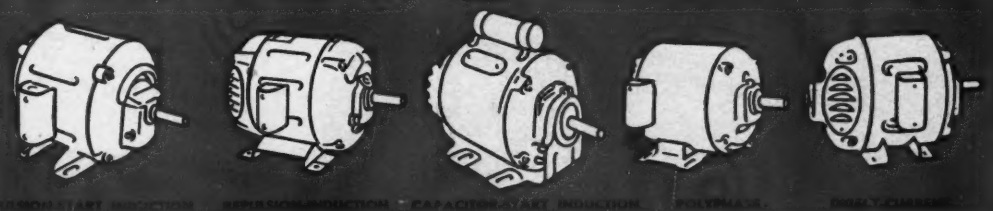

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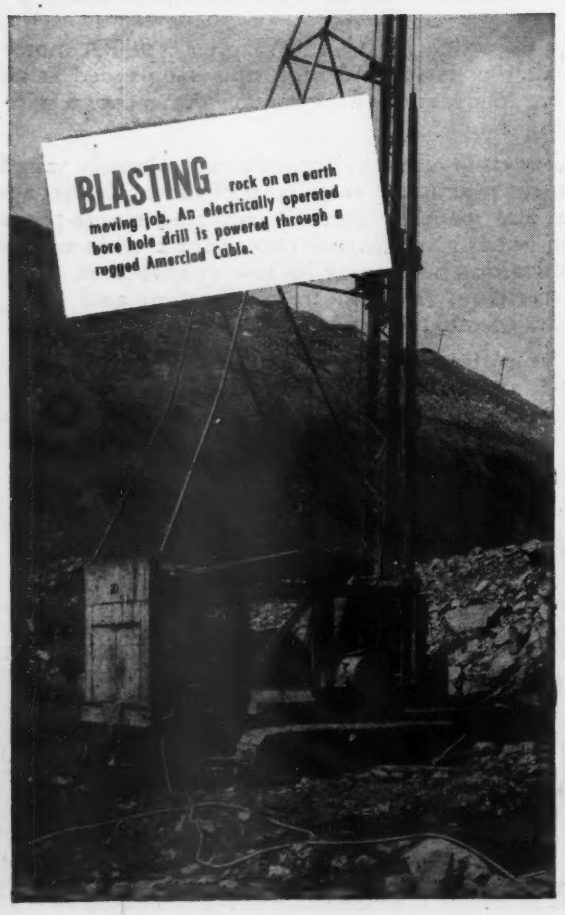

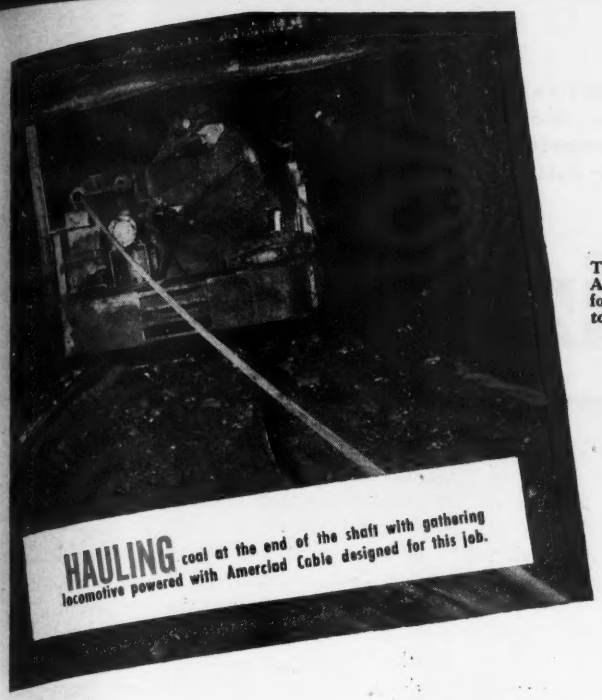

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Reader's Quiz

Calculating Electric Water Heating

QUESTION 224—I would like to know whether it is practical to heat a large amount of water by electricity.

A customer of mine wants to heat five green houses by electricity. At present, he is heating by hot water using two 80 hp. boilers and burning 300 cords of wood in six months. It is a lot of bother and he wants it more convenient.

I don't know the capacity of the boilers in gallons of water. Leading from the boilers through the green houses are 70 two-hundred-foot runs of 2 inch pipe with five 20 ft. runs of 6 inch pipe across the ends of the houses.

Would it be more economical for him to continue to heat with hot water using electricity to heat the water, or to use space heaters?

How would I go about to figure the load it would take to heat the water? Is there any way of telling how much electricity it would take to heat 100 gallons of water to 212° F?—J. H. M.

A. TO QUESTION 224—Heating large amounts of water by electricity is not economical. It is practical for households and small institutions where consumption is neither large nor continuous. In such cases, the cost of equipment can be held down, heating the water slowly and depending upon storage.

One British-thermal-unit (B.t.u.) is (roughly) the amount of heat required to raise one pound of water one degree Fahrenheit in temperature. One kilowatt-hour is equal to 3415 B.t.u.

Not knowing the kind of wood, or its condition, the weight per cord and the heating value per pound are arbitrarily chosen from tables of averages. They are here assumed as 3500 lbs./cord and 5500 B.t.u.-lb. (aid dry).

Since the consumption of wood is known, no computation of heat loss through the glass and other parts of the buildings is necessary. Nor is it necessary to compute the volume of the water and its rate of heat transfer.

At the assumed values, a cord of wood has a heating value of 3500 lb. x 5500 B.t.u./lb. = 19,250,000 Btu./cord. The heat applied to the furnace during a 6-month heating season is 19,250,000 B.t.u./cord x 300 cords = 5,775,000,000 Btu./season (This figure will be used later.)

Use of space heaters would avoid conversion losses (stack losses, losses through insulation, etc.) in a water heating plant. So, the electrical heating can be calculated at 94 percent efficiency to cover only circuit losses.

The wood-firing probably operates at about 50 percent efficiency. Then, only half of the heat (in the wood) is actually used to overcome heat losses in the building.

$$\frac{5,775,000,000}{2} = 2,887,500 \text{ B.t.u.}$$

To find the kilowatt-hours for the heating season, the basic heat requirement (at 100 percent efficiency) is divided by the number of kilowatt-hours in a B.t.u. and by the assumed efficiency of the electrical system.

$$\frac{2,887,500}{3413 \times .94} = 900,000 \text{ kw-hr.}$$

For fuel expense, it is necessary now only to equate the cost of 900,000 kw-hr. against the cost of 300 cords of wood. If a fireman must be hired especially for the heating season, his wages must be added to the cost of the wood.

There are 4320 hours in a six-month period. Dividing 900,000 kw-hr. by 4320 would indicate an average load of 200 kw. The peak load during severe weather may easily reach more than ten times 200 kw.

Other alternates are to convert the present boilers to other fuels, such as stoker-fired slack coal, oil, or gas. The boiler efficiency would be about the same in each case. To find the fuel required, it would be necessary to divide 5,775,000,000 B.t.u. by the heating value of the fuel, which can be assumed at 15,000 B.t.u./lb. (coal), 126,000 B.t.u./gal. (oil) and 1000 B.t.u./cu. ft. (gas). Through the use of thermostats, the installation can be made automatic.

The use of an average heating load is misleading when laying out the plant. In order to be sure that the equipment will handle the peak load during severe weather (and is not larger than needed) the maximum heat loss must be known (this depends upon the building construction and the weather) as well as the guaranteed burner performance.

To decide the economies of conversion, the cost of the additional equipment is divided by the expected savings in labor and fuel—L.E.B.

A. TO QUESTION 224—To find the cost of heating large quantities of water by electricity, the required gallons per hour must be determined. This calculation depends on the temperature to be maintained in the buildings and the efficiency of the heating system. The following conversion factors are used in arriving at cost figures.

1 boiler hp. = 34.5 lbs water evaporated per hour from a feedwater temperature of 212 degrees F. into dry steam at same temp.

1 gal. water = 8.34 lbs.

1 B.t.u. = amount of heat required to raise the temp. of one lb. of water one degree F.

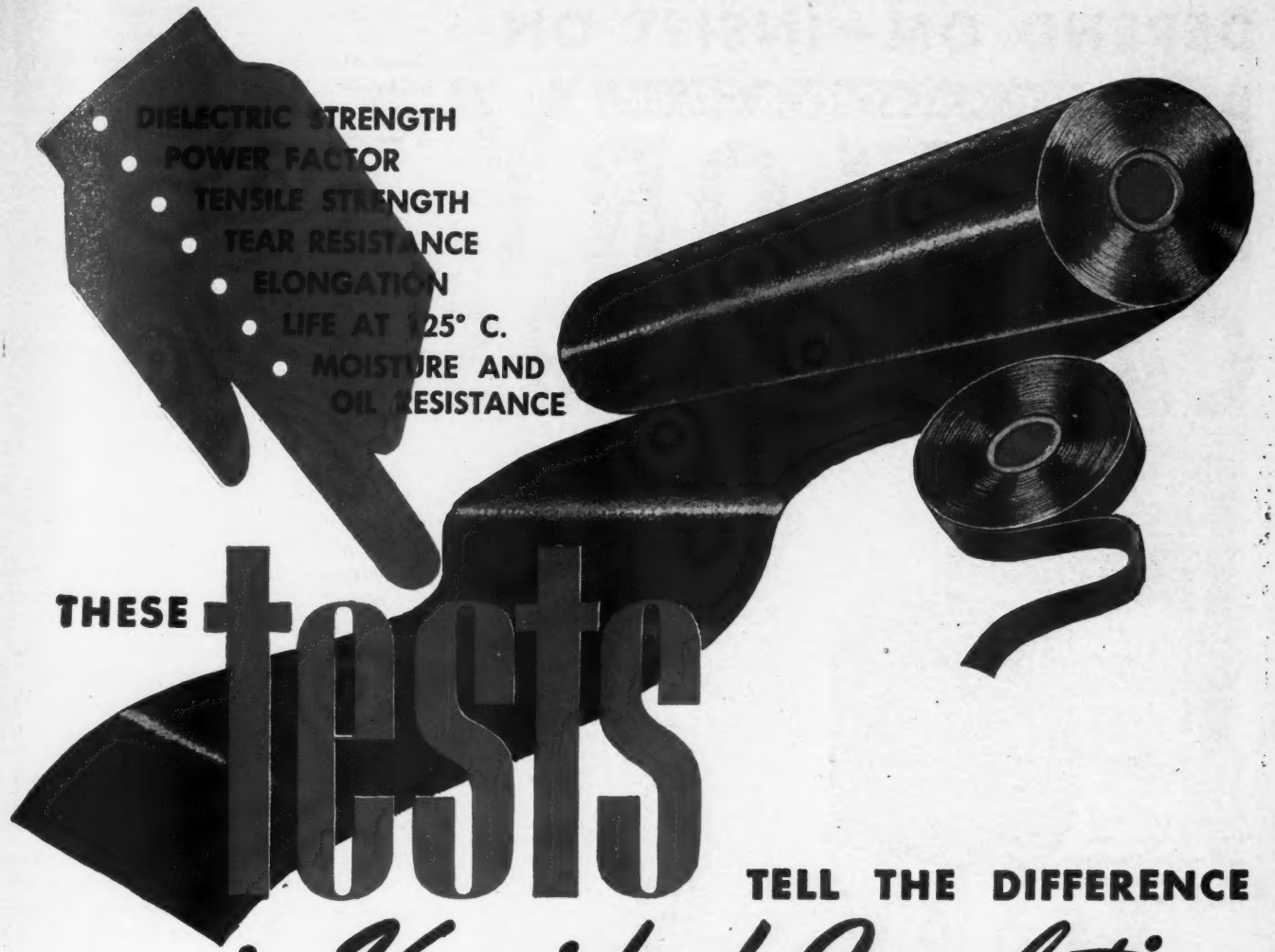
1 Kw-hr. = 3415 B.t.u.

Therefore, to determine the requirements for this application, the temperature of the feedwater must be known or calculated. Since the rated horsepower of the boilers is known, the gallons of water may be calculated from above conversion factors.

In this particular application, I believe substitution of space heaters for the hot water system would be more economical. Advantages would include reduced maintenance, flexibility, thermostatic control, and additional convenience.

The kilowatt-hours required to heat water (second part of question) may be calculated as follows:

Determine the average temperature



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These carefully selected base fabrics are then uniformly coated with Irvington insulating varnishes ... manufactured entirely of tested ingredients ... specific gravity and viscosity controlled for coating fabric. ***Only by using insulating varnishes that are correctly formulated and processed can varnished insulations with full dielectric strength, moisture resistance, heat resistance and long life be secured.***

To assure the best possible insulation values and meet hundreds of different customer specifications, Irvington Varnished Insulations are quality-controlled by over 65 checks. Convince yourself of their outstanding characteristics. Write for samples to make comparative tests.

The red core identifies Irvington insulating cloth and tape. →

Look to IRVINGTON for Continued Leadership in Insulation

IRVINGTON
Varnish and Insulator Company
IRVINGTON 11, NEW JERSEY, U. S. A.

of the inlet water (for these calculations 50 degrees F. is assumed).

Determine weight of the water—100 gal. x 8.34 lbs. = 834 lbs.

Determine temperature difference—212—50 (inlet water) = 162 degrees F.

Calculate heat necessary to raise water temperature—

834 lbs. x 1 B.t.u. x 162 degrees = 135,108 B.t.u.

Convert B.t.u. to Kwh.

$$\frac{135{,}108 \text{ B.t.u.}}{3415 \text{ (B.t.u./kwhr.)}} = 39.6 \text{ Kwh.}$$

If the tank containing the water is insulated, it will be safe to assume an efficiency of approximately 90 percent.

$$\frac{39.6 \text{ Kw-Hr}}{.90} = 44.0 \text{ Kwh.}$$

The kilowatt-hours required multiplied by the prevailing power rate in your locality will give the cost of heating the water. This will be the power requirements per hour.—H.T.O.

A. TO QUESTION 224—The main obstacle to electric heating for buildings is the cost of current. Unless the electric rates are greatly reduced, it is not economical to heat the greenhouses in this problem by electricity compared with the present wood burning boilers. The following analysis illustrates this point.

The problem states that there are two 80 hp. hot water boilers, burning 300 cords of wood in six months. Dividing this fuel consumption evenly over the time period, 1.67 cords would be used per day. The heat value of the wood varies according to the type and dryness, an average figure being 15 million B.t.u. per cord. Then the heat input will be 1,045,000 B.t.u. per hour. Expressing this in terms of watts, since one watt of electricity is equivalent to 3.4 B.t.u. per hour, the consumption of electric energy will be 308,000 watts or 308 kwh.

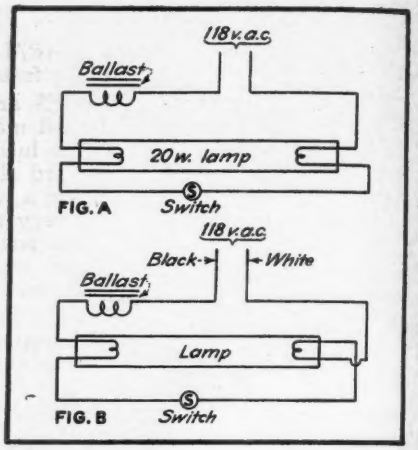
Actually only half of this amount will be required, since an electric boiler is twice or more efficient than a wood burning boiler. Then the cost of heating with electricity, assuming 1.5 cent per kwh., will be $2.30 per hour. This cost can be reduced 15 to 20 percent by space heaters since the secondary medium for heat transfer is absent and the overall efficiency is higher. Even then the cost of electric heating will be beyond comparison.

Answering the second part of the question, the amount of electricity to heat 100 gallons of water to 212 degrees F. will depend on the number of degrees through which the water temperature must be raised and the time required to do this. If this volume is to be raised from say 192 to 212 degrees F. in one hour, then the amount of heat required is 100 x 8.33 x 1.0 x (212 — 192) = 16,700 B.t.u. per

hour (where 8.33 is the number of pounds in a gallon of water and 1.0 is the specific heat of water in B.t.u. per pounds). As stated above, one watt of electricity is equivalent to 3.4 B.t.u. per hour; therefore, 16,700/3.4 or 4.9 kwh. will be required.—A.W.C.

Fluorescent Lamp Blink

QUESTION 225—Why should the lamp blink when hooked up as in Fig. A and when hooked as in Fig. B the blinking is eliminated? The voltage at the line was 118 volts. The black wire was hooked to the one side of the ballast and all other conditions seemed proper in every detail.—D.J.S.



A. TO QUESTION 225—From the description given, the probable trouble causing the lamp to blink may be the incorrect connecting of the starter socket. Fig. C shows

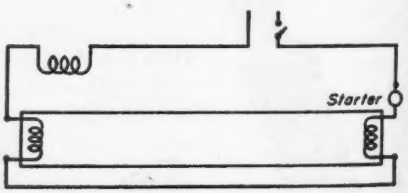


Fig. C

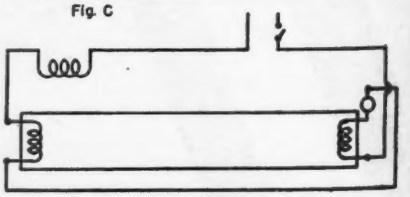
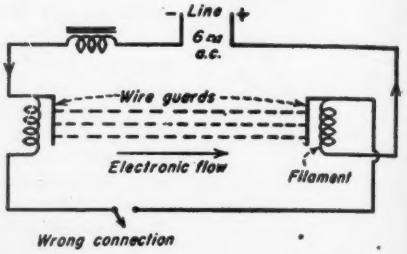


Fig. D

the probable error, the starter functioning but making and breaking the circuit and causing blinking. Fig. D shows the correct connection.—J.R.

A. TO QUESTION 225—At each end of the fluorescent tube there is a coiled filament of tungsten wire treated to release a large quantity of electrons when heated. Adjacent and connected to these fila-

ments are wire guards to intercept the electronic flow through the tube after the preheating stage. Electrons are negative charges and flow from the cathode (negative) to the anode (positive). The wire guards act alternately as anodes or cathodes in relation to the polarity reversals of the supply line. When properly connected each end of the wire guards run directly to the line in series with the ballast. Should one end of the lamp terminals be reversed—at the instant of electron flow from cathode to anode, rather than the circuit completing itself directly to the line it will flow from the wire guard (acting as an anode



at this instant) through the tungsten filament to line. This of course heats the filament (at the anode end) which will release electrons to oppose the electronic flow from the cathode (opposite end). The blinking action is caused by these two sources of electrons "bucking" each other sufficiently to actually neutralize the flow through the lamp at instants determined by the thermal lag of the filament in question. The wire guards are necessary to prevent this blinking and to prolong the life of the filaments.—J.J.R.

Can you ANSWER these QUESTIONS?

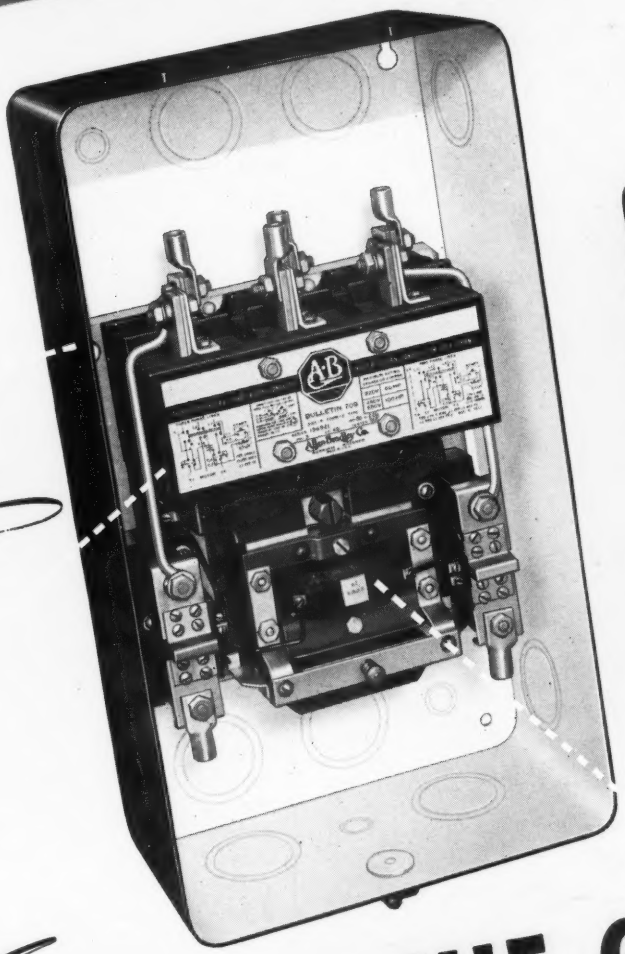
—I would like to know how to find the voltage and horsepower rating of a three phase squirrel cage motor without a nameplate.—J.G.

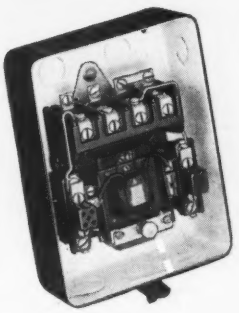
QUESTION G10—I would like to know why ¼ hp. single phase motors seem to run very hot after they are rewound. The current input is still below nameplate reading and speed is normal.

As far as I know, the right number of turns are replaced and the coils are put in their proper slots. The rotors seem to be in excellent condition. Is it possible that an open flame fire on the core to burn out the old winding would have any bad effects on the laminations?—F.F.

PLEASE SEND IN YOUR ANSWERS BY OCTOBER 15

From any angle...





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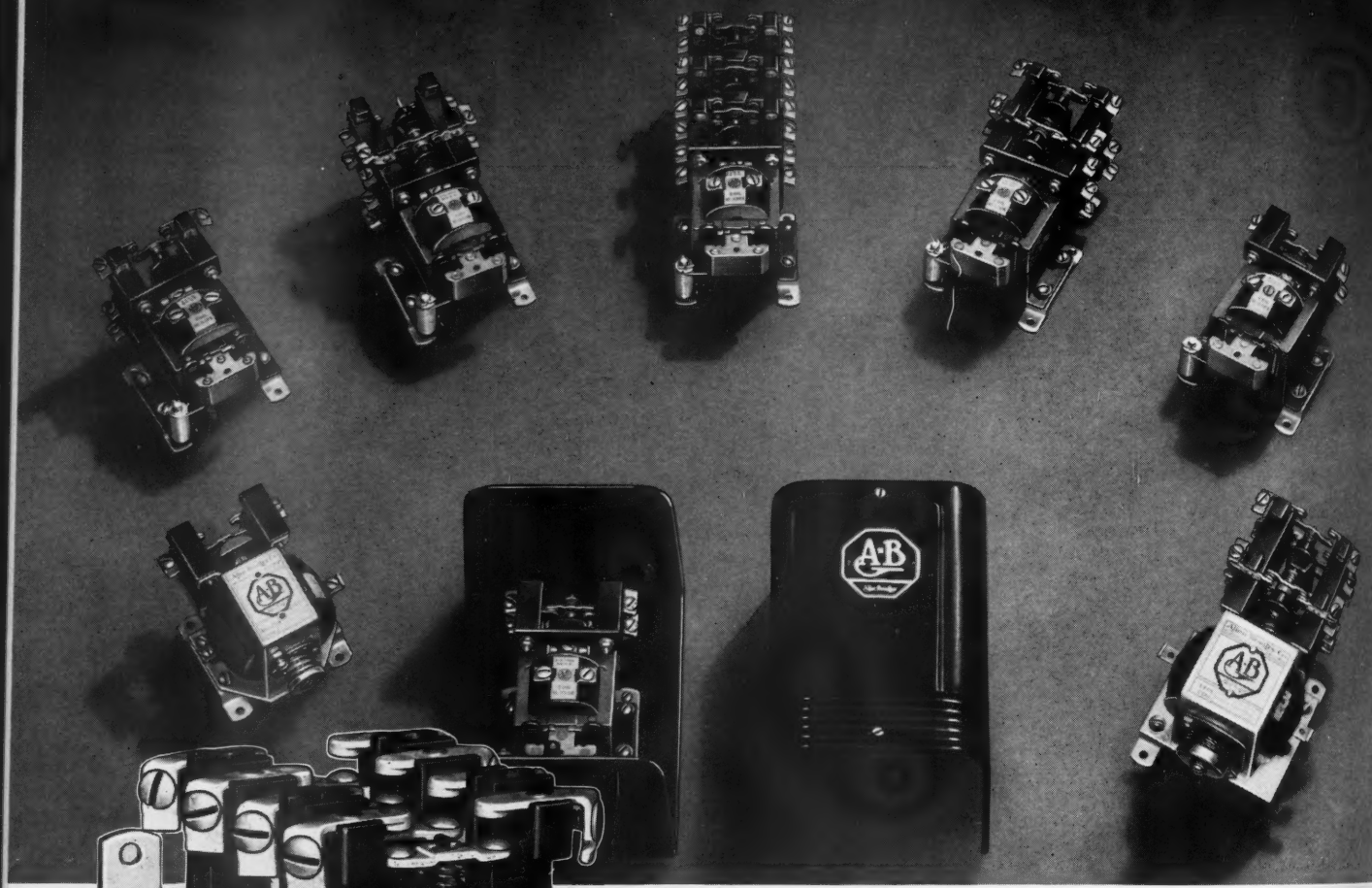

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SOLENOID MOTOR CONTROL

QUALITY

Motor Shops

Fibre Spools For Magnet Coils

A simple gadget that can be made and used by any motor repair shop took first prize honors in last year's NISA Award Contest. Submitted by W. H. Essig of Wingfield & Hundley, motor service shop of Richmond, Va., and released for publication by NISA headquarters, the idea embodies the design of a fibre spool on which magnet coils can be wound.

Outstanding feature of the device is the lock-tight and washers of the spool. After cutting a fibre tube the proper

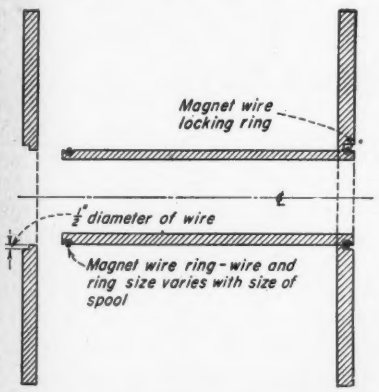


FIG. 1—Cross-section of fibre spool for winding magnet coils. Note wire ring lock-tight feature of spool end-washers.

length, Mr. Essig turned a groove near each end of the tube (see Fig. 1). The groove width is approximately the diameter of a No. 18 or No. 20 wire; its depth about one-half the wire diameter. The fibre end-washers of the spool are then bored to fit over the tube. An additional counter-bore is made just slightly deeper than one-half the thickness of the washer fibre and to a diameter that will take care of one-half the thickness of the wire mentioned above.

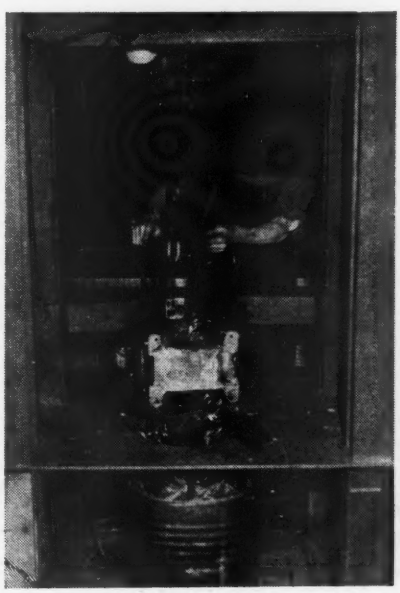
The washers are slipped on the tube (counter-bore facing tube ends); a piece of magnet wire of the size indicated is laid in the groove of the spool (ends of wire must not butt) to form a locking ring. The washers are then pulled back over the wire ring and firmly locked in place.

Mr. Essig reports that the spool is simple to construct and that the end washers will not come off while the coil is being wound or used.

Vertical Coil Pull Protects Stators

Stator windings are stripped cleanly, safely and effortlessly in the shop of the Electric Service Repair Company, Paterson, New Jersey, by a vertically sliding piston. A framework of 4-inch H-columns support a ⅝-inch steel-plate work table 32 inches above the shop floor and a 2 hp. motor six feet above the working plane. Horizontal steel arms are gibbed to slide along the front H-Columns, extend inwards over the stripping table and are counter-balanced to permit easy vertical movement and adjustment. A stator to be stripped of damaged windings is placed on the table with slots vertical and the adjustable arms are lowered to the point of contact with the motor frame. Locking nuts on the gibs clamp the arms, holding the stator rigidly to the table.

The overhead 2 hp. motor, operated through pressure on a foot switch, turns a flywheel which in turn operates a piston sliding vertically between the H-columns directly over the clamped stator. A heavy wire guard arches in front of the piston to protect the machine operator. Swiveled to the bottom of the piston is a short horizontal arm which can be swung to any azimuth. A chain drop from this arm holds a pair of wire tongs which clamp the coils being pulled. The machine operator guides the tongs around the coils and the piston exerts the stripping vertical force. Since the piston swivel arm can be rotated to any azimuth, the tongs can be placed exactly over the coil and the vertical pull removes the winding cleanly, eliminating any possibility of damaging the stator slot edges or ends. A circular hole in the working table, located behind the clamped stator, allows the machine operator to drop pulled wire directly into a container below the table, saving an extra shop cleaning operation. As the piston rises and falls, successive windings are gripped, pulled and dropped through the hole in a continuous cycle. The preliminary burning is done by using gas and air twined through hose connections to the burning jet.

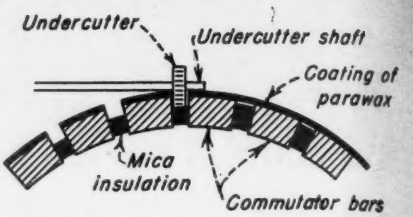


Rear view of stripping table shows stator clamped by sliding counter-weighted side arms. Overhead piston activates chain which exerts upward pull on windings. Coils are grasped by tongs and pulled by the piston. Wire is dropped into container below hole in steel-plate work table.

Coating Protects Undercut Commutator

Among the shop ideas entered in last year's NISA Award Contest and released for publication by NISA headquarters, was a method of protecting copper commutator bars during an under cutting operation. Submitted by Rosco Dunlap of the Industrial Engineering Equipment Co., Davenport, Iowa, it embraces a simple application of wax to the commutator surface.

Before undercutting a commutator, employees of the shop apply a protective coat of Parawax to the copper bars. To be most effective, the entire length and width of each bar must be covered. Use of the wax, according to Mr. Dunlap, provides two distinct advantages: (1) It prevents the rotating shaft of the undercutter from marring the copper surface and (2) it enables the operator to *feel the pull of the saw* rather than the drag of the rotating shaft on the commutator. Sensing this pull the operator can then apply the proper pressure to the under-



Sectional view of a commutator showing use of protective wax film during undercutting operation.

cutter. Also, there is less danger of the saw jumping out of the slot and damaging the bars.

When undercutting is completed, the protective wax coating is quickly removed with a cloth dampened with a wax solvent (paint thinner is sometimes used). The commutator is then polished.

Dunlap reports that the application of the wax coating cuts the undercutting time from 15 to 20 minutes on small commutators and proportionately more on the larger units.

Wire Baler is Space Saver

Many motor shops have made a practice of baling damaged wire into compact, easily handled bales, yet it is surprising to find how may concerns store waste wire in bulky, tangled piles awaiting disposal. In locations where junk disposal is infrequent, the bales conserve storage space and greatly improve the appearance and safety of the shop. The Electric Maintenance Company, Inc., Boston, Mass., utilizes a salvaged Economy paper baler for this purpose and a hand truck for moving the wired bales to the storage bin. The bales weigh up to 400 pounds.

Converted paper baling machine forms loose, tangled, damaged and waste wire windings into compact, easily handled, neat bales weighing approximately 400 pounds and measuring 3 cubic feet.

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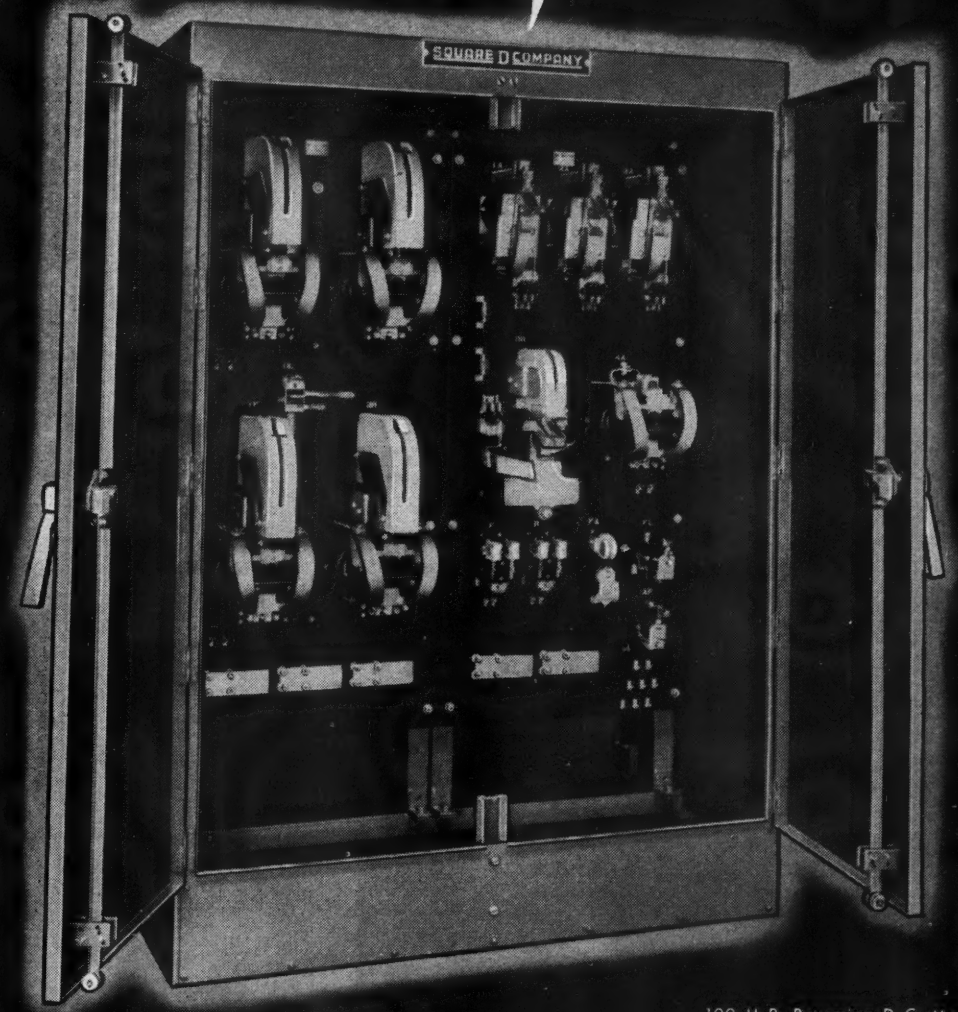

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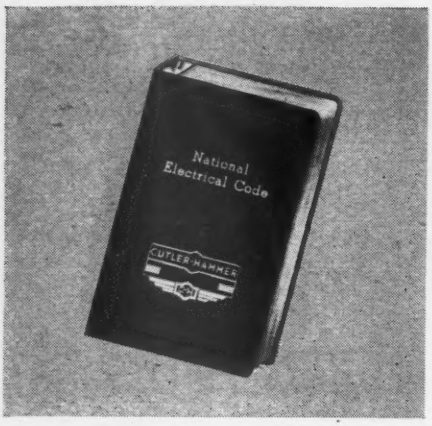

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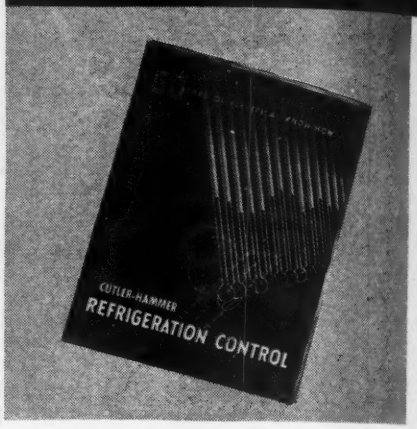

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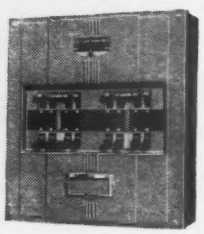

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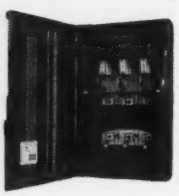

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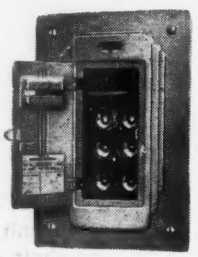
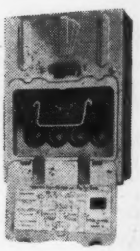
Cat. No. 4334H15. 60 Ampere main and range switch with 4 plug fuse circuits. Available with 30 amp. pull-out instead of 60. Flush or surface mounting.



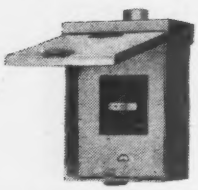
Push-Pull Operated Fuseless Main Switch

Cat. No. 4302H3. 30 Amp. with 6 branch circuits. Flush or surface mounting. No main fuses required.



Range Switch with Toggle Fuseless Main

Cat. No. 4302H17. 60 or 100 Ampere Main Switch with 4 plug fuse and one 60 amp. circuit. No main fuses required. Flush or surface mounting.



Single Pull-Out Main Switch

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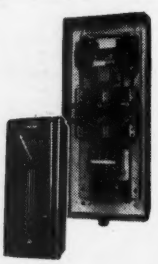
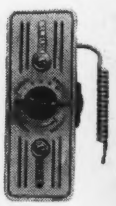


Combination Starter

Cat. No. 9589. Magnetic starter and fusible safety switch combined in one compact, easy-to-wire enclosure.



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Cat. No. 9521N23. Single button stainless steel temperature control for general refrigeration replacement use.

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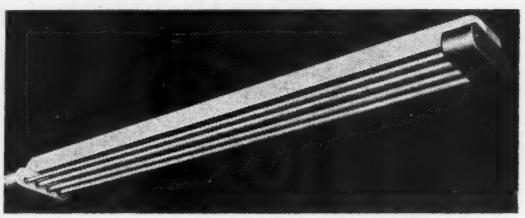
THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

Equipment News

Fluorescent Lighting Fixture

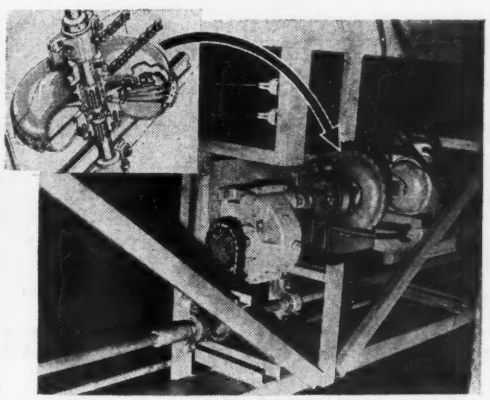
The new Woodworth cold cathode fluorescent lighting fixture is for commercial use. Available for ceiling mounting or stem suspension the fixture is 8 feet long and 12½ inches wide and can be had with two lamps or four lamps. All internal parts are interconnected and lead wires bought to outlet ready for splicing to building service. Transformers are rated at 900 volts on the secondary side and operate from regular 110 volt a-c line. It is claimed that a patented safety feature prevents any possibility of shock when changing lamps. It has Underwriters approval. Colonial Lighting Company, Inc., 2901 Tonnele Avenue, North Bergen, N. J.



COLONIAL FIXTURE

Fluid Drive Coupling

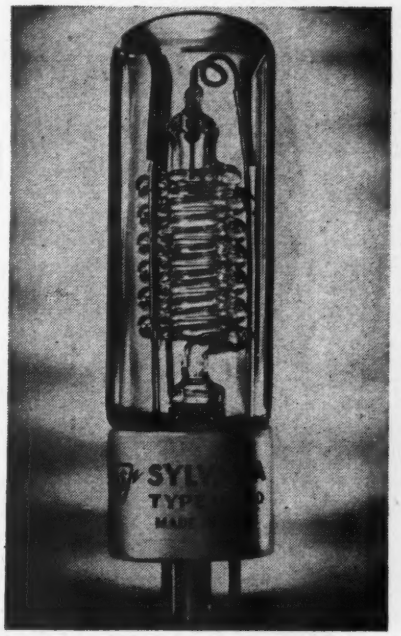
This fluid drive coupling operates on the Vulcan-Sinclair principle and eliminates the necessity for both a transmission and differential mechanism. The unit is self-contained. It can be installed directly on the shaft of any engine or electric motor. Some of its uses are for cranes, refrigeration units, hoists, winches, conveyor systems, packaging machines, and wherever smooth starting and stopping of power driven equipment is necessary. Coupling is enclosed, preventing entrance of dirt and dust. Toolcraft Manufacturing Company, Huntington Park, Calif.



TOOLCRAFT COUPLING

Electronic Flash Tube

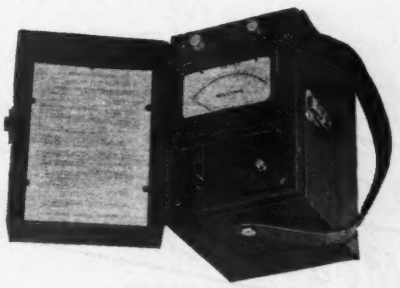
A new gas discharge flash tube providing instantaneous high intensity light for press, portrait, studio and industrial photography; obstruction markers; marine and airway beacons; airport boundary markers; and other similar signaling applications has been announced. The tube may be operated in a relatively simple condenser discharge circuit to provide flashes of 1/5000 second duration with a peak light output of 12 million lumens, manufacturer claims. Equipment may be designed to operate wholly from portable battery power or directly from 120 volt a-c line. R4330 flash tube is mounted in a T-11 bulb; measures 5-15/32-in. over medium ceramic octal base and is 1-13/32-in. in diameter. Electronics Division, Sylvania Electric Products Inc., 500 Fifth Avenue. New York 18, N. Y.



SYLVANIA FLASH TUBE

Insulation Resistance Meter

A portable, self-contained insulation resistance meter, testing to 50,000 megohms has been announced. The new unit, Model 261 Vibrotest, provides positive and definite reading of true resistances to this new wide range, it is claimed. It calibrates at infinity, has a high voltage regulator in the measuring circuit and is equipped with condenser charging circuit to facilitate faster testing of condensers or capacity circuits. Two No. 6, 1½ volt dry cells provide power of 500 volts. Associated Research, Inc., 231 So. Green St., Chicago 7, Ill.



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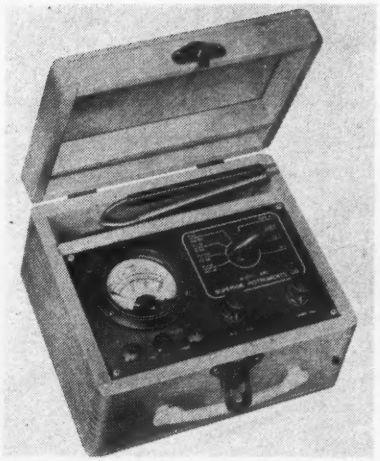
● There's perpetual beauty in the simple, graceful lines of these fixtures by Virden. There's also a quality of airiness that pleases the eye and proclaims good taste. More than that, there's the comfortable assurance of structural integrity and master craftsmanship that spells Virden Value. You can get them from your Virden jobber.

John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute

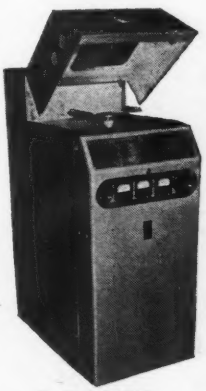
Instrument



METROPOLITAN MULTIMETER

This new 5,000 ohms per volt multimeter, Model 680, features a single scale for all voltage and current measurements. It is claimed that the unique circuit design results in close-to-perfect linear scale with no variation between a-c and d-c measurements, permitting all voltage and current readings both a-c and d-c to be made from the same scale. It uses a microampere meter movement shunted down to a sensitivity of 200 microamperes to enable d-c measurements at 5,000 ohms per volt. The electro-magnetic meter has a full scale deflection of 150 microamperes, and it is practical to determine resonance in diode circuits, for instance second detectors of superheterodynes, by putting the instrument in series with the diode load resistor and being guided by largest deflection. Metropolitan Electronic & Instrument Co., 6 Murray St., New York 7, N. Y.

Dielectric Heater



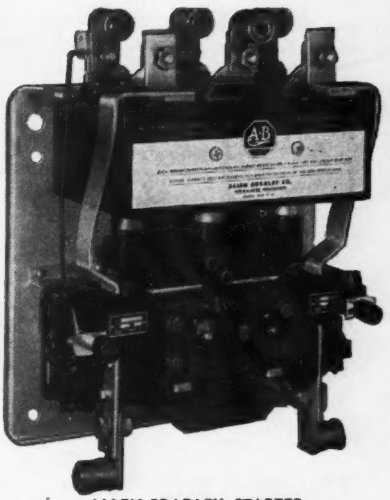
G. E. HEATER

A new electronic heater for dielectric heating of plastic preforms has been announced. It is designed for operation at 40 megacycles, using a water-cooled oscillator tube. This tube, operating at a high frequency and having a generous short time overload capacity, makes possible the use of an average full power 5 kw. output during the entire heating cycle. After the plastic preforms are placed on the electrode of the oven-like preheater and the cover is closed, the preheat cycle is started by means of a push-button station. The oven cover opens automatically at the end of the preset heating cycle, and the operator then transfers the preforms to the adjacent molding press. All controls except pushbuttons are located behind the locked front door. General Electric Company, Schenectady, N. Y.

Automatic Time Control

A timer for either one or two circuits is available to control signs, display lighting, heating and ventilating. Originally designed for use in poultry houses, the timer turns lights on and off and operates the lamps in either a dimmed or a brightly burning condition. A sealed-in-oil Telechron clock motor, mercury to mercury controls in Pyrex tubes and the absence of springs to wear or break are some of the advantages. There is no resistance to burn out and the clock is self starting. From one to eighteen pre-set operations may be motivated during a single 24-hour period. The power ratings are 1300 watts and above. E. D. Rose Sales Agent, 11125 Lake Ave., Cleveland 2, Ohio.

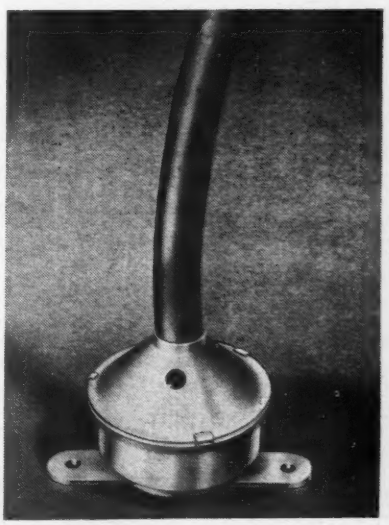
Solenoid Starter



ALLEN-BRADLEY STARTER

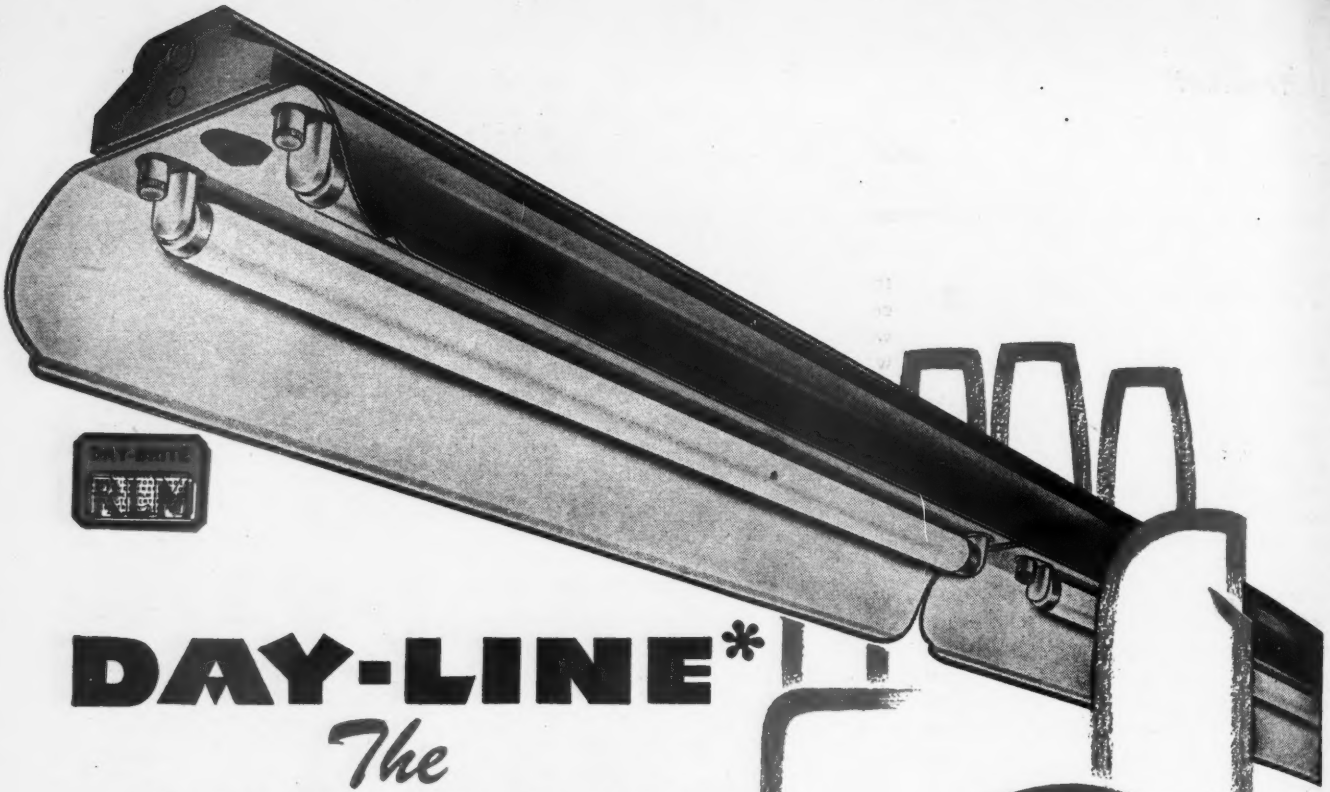
Size 5, Bulletin 709 solenoid starter has a maximum horsepower rating of 100 hp., 220 volts and 200 hp., 440-550-600 volts. All the features of the smaller starters are incorporated in this new size 5 solenoid starter. The double break, cadmium silver contacts are totally encased in an arc hood, each pole of the switch having its individual arc chamber. The starter is mounted on a self-insulated metal base plate, which may be mounted on any metal surface without extra insulation. It can be provided with or without an enclosure. The enclosed starter is available in the NEMA Type 1 sheet metal enclosure for general purpose applications, as well as the NEMA Type 4, water-tight and weatherproof; NEMA Type 5, for non-hazardous dust. Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis.

Thermostat



SPENCER THERMOSTAT

A new Klixon hermetically sealed snap-action thermostat C-4910 for temperature regulation or high limit alarms in refrigeration or other cooling or heating applications is available. It is for use in deep freeze units, frozen food cabinets, bottle dispensers, refrigerated show cases and walk-in coolers, as well as in heating applications requiring a hermetically sealed snap action thermostat. Unit is actuated by the Spencer snap-acting disc mounted in thermal contact with the sealed housing and will operate in any position. Thermostats are available for a-c or d-c application—115-230 volts a-c, 10 amps., ½ hp.; 125 volts d-c 1 amp. The Spencer Thermostat Company, Attleboro, Mass.



DAY-LINE*

The "ONE-MAN" *Fixture*

This heavy-duty Day-Brite Industrial Fluorescent system saves time and money on every installation —every service operation:

- **One man *alone* can quickly hang the Day-Line with chain or patented Day-Brite "Ice-Tong" hangers.**
- **Rugged, die-formed steel channels designed for simplified unit or continuous mounting—plenty of knockouts.**
- **Lifetime porcelain enameled steel reflectors fastened with two captive wing nuts can be removed and replaced in one minute for easy installation and servicing—*without tools.***

Day-Brite Lighting, Inc., 5401 Bulwer Avenue, St. Louis 7, Mo. Nationally distributed through leading electrical supply houses.

In Canada: address inquiries to Amalgamated Electric Corporation, Ltd., Toronto 6, Ontario.

* Patent Nos. 2317434, D135375, D133458 94a

IT'S EASY TO SEE WHEN IT'S

DAY-BRITE

Lighting

Modern Lighting

Planned Lighting in New Men's Store

Another example of *Planned* "Light for Selling" is exemplified in the new Fifth Avenue store of Richard Bennett Associates, Inc., New York City. It combines decorative cove lighting with recessed direct lighting for general illumination, and fingertip-controlled adjustable floodlights for wall display lighting.

This store, newest of a New York chain, sells men's high grade custom made suits. Modern in design, it has been planned carefully from a layout standpoint to make it easy for the customer to select the type of cloth from which his suit will be made. As the customer enters the store, special display racks built into the left wall present an array of suiting materials from which he may make his selection. The store designer's problem was to feature this wall display with a high intensity of good color quality illumination, provide general illumination of a pleasing quality throughout the store, and to light the ceiling softly to prevent excessive contrasts in brightnesses. Just how this problem was satisfactorily solved is shown in the accompanying illustrations and in the following detailed description.

The store front, including the entrance door, is of all-glass construction. The plate glass front is set back three feet from the sidewalk, or building line, forming an alcove for window shoppers. This permits shoppers to get off the sidewalk, out of the line of pedestrian traffic, and offers some protection against inclement weather. An open display behind the glass front forms a show window. This window is lighted with four 300 watt type R-40 lamps housed in stem suspended "bullet" fixtures. Another show window, three feet deep and nine feet long, extends along the left wall of the front entrance from the sidewalk line into the store interior. This window is lighted by five 300 watt type R-40 lamps concealed in flush mounted housings which permit universal adjustment in any direction. These units are recessed in the suspended ceiling over the window.

Inside the store, ten "Rotobeam" adjustable spotlights with touch control focusing, are recessed flush in the ceiling seven feet out from the special wall display. Each unit is equipped with a PAR-38 150 watt lamp, with spread lens and daylight filter. These units are easily adjustable to any angle, which permits uniform lighting on the wall display. The intensity on this display from these units, and from the general illumination, is over 30 foot-candles on the vertical surface. The color quality is excellent, being a mixture of the daylight color quality from the "Rotobeam" units, and of the standard incandescent and fluorescent lamps used for general lighting.

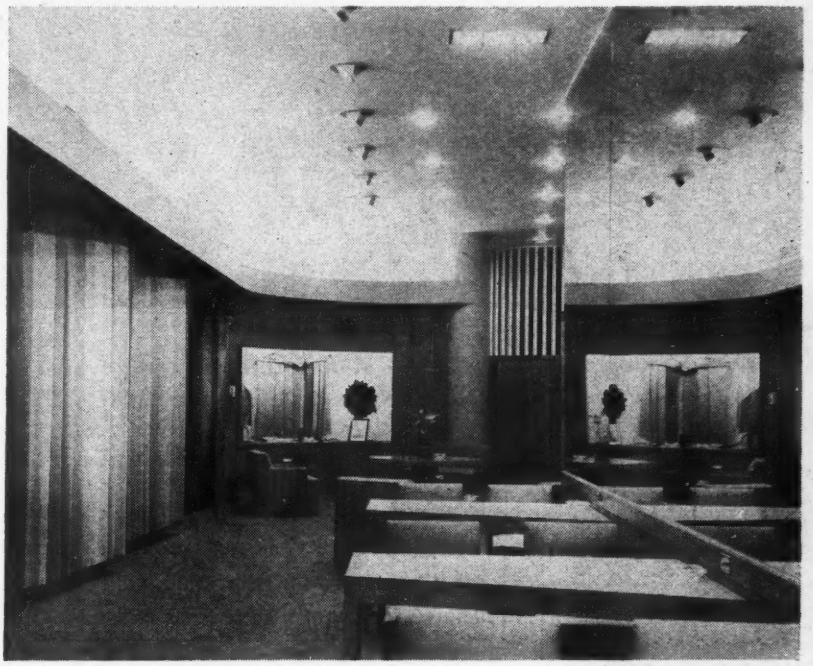
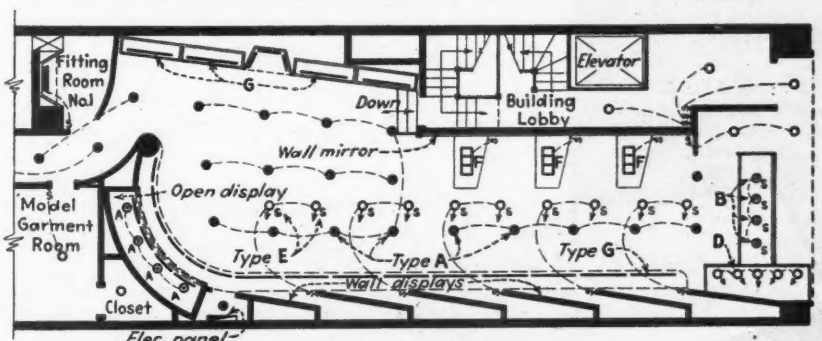


FIG. 1—Wall display of men's suiting material for custom clothes is lighted by "Rotobeam" floodlights recessed in ceiling at Richard Bennett's Fifth Avenue store, New York City.



Electric Symbols

- ○ Ceiling outlet
- A ● Recessed 150 W. R-40 with plaster frame
- B ⊙S Bullet fixture - stem - 300 W.
- C ⊙A Bullet fixture with universal joint, 150 W.
- D ◎ "Rotobeam" adj. recessed spotlight with touch control focusing for 300 W
- E ◎S "Rotobeam" adj. recessed spotlight with spread lens; daylight color filter attachment and holder. With plaster ring. 150 W.
- F ▯ Three-lens recessed spotlights flush with ceiling, for 3-150 W.
- G — Fluorescent strips
- S Switch

FIG. 2—Floor plan showing planned lighting layout.

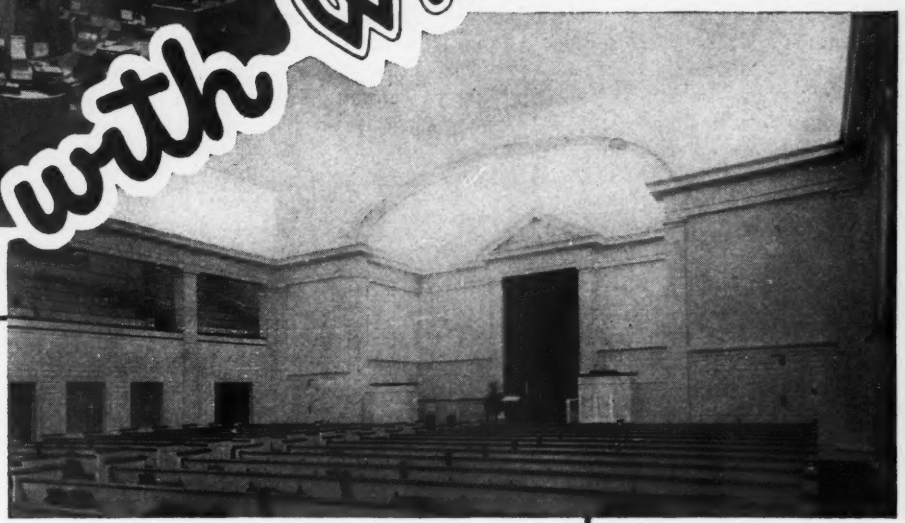
General illumination is provided by 19—150 watt R-40 type lamps recessed flush in the ceiling on a plaster ring; three 3-lens units each equipped with three 150 watt standard lamps, and by a continuous line of 40 watt daylight fluorescent lamps concealed in a cove over the wall display racks. This general illumination exceeds 30 footcandles on a horizontal plane 30 inches from the floor.

Opposite the wall display racks are three customer's tables which extend out from the opposite wall. The three 3-lens units are recessed flush in the ceiling over these tables. The designer has created an illusion of spaciousness in this narrow (13 foot) store by using a full mirror for the wall opposite the display wall. This mirror extends from the front door to the offset in the wall where the store becomes wider, reaching from the dado line above the customer's tables to the ceiling (Fig. 1). An open display is set in the curving rear wall of the store, lighted by four 150-watt type R-40 lamps and four 20 watt fluorescent lamps. The lighting in this rear wall display, in the two front show windows, and on the side wall displays is controlled by a time switch, which permits these units to be lighted at night when the store is closed. Thus, the attention of night window shoppers is drawn to this store, and the all-glass front permits inspection of the entire store interior.

Lighting for this store was planned by Theodore Yonkler and Eugene Back, architectural designers. All lighting equipment was furnished by General Lighting Company, New York.

All set to specialize in industrial, commercial and residential lighting and electrical construction work is the reorganized Circle L Electric Company of Tulsa, Oklahoma. Top management includes (L to R) Allen D. West, engineer; Wm. R. Henson, president; and L. A. "Pinky" West, vice-president. Present plans include expansion of existing quarters to include a showroom, stockroom and more office space.

EVERY ADEQUATE LIGHTING JOB
starts with an ADEQUATE WIRING JOB



Wire it with WIREMOLD

THE years ahead will be LIGHTING YEARS for most electrical contractors . . . and the requirements in new wiring and rewiring will be at once extensive and widely varied. Jobs will range all the way from architecturally built-in installations to straight lighting of mill type building space.

But no matter what the problem, or what type of fixture and light source is to be used, the chances are that Wiremold will be your "best bet" for the wiring. There are 10 basic Wiremold Systems, each with its complete range of fittings and all interconnectable one with another. These include Wiremold systems and fittings for Fluorescent, Showcase, Strip and Industrial Lighting installations. With Wiremold you are indeed equipped to do a MORE than Adequate Wiring job for the new lighting needs of today and tomorrow.

Write us for the Wiremold Catalog and Wiring Guide, also for New Bulletin covering Wiremold uses.

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Know your WIREMOLD

.... MORE THAN ADEQUATE WIRING

FROM PANEL BOX TO OUTLETS

In the News

OPA Grants Price Increases

Manufacturers of lighting fixtures and parts have been given a 10 percent interim increase over their base ceiling prices for these products, effective August 13, the Office of Price Administration announced recently.

All types of non-portable lighting fixtures, both fluorescent and incandescent, for industrial, commercial or residential use and all parts for these fixtures are included.

Maximum prices for boxes and covers for electrical outlets and switches have been raised 19 percent at the manufacturers' level. Resellers of these products, which are widely used by householders, may add the same percentage amounts to their ceiling prices as their net invoiced costs are raised as a result of increase in manufacturers' price. This action became effective August 17.

Wiring Devices Added to HH Ratings

Nails, builders' hardware, electrical wiring devices, and a number of other metal building materials have been added to the list of items for which builders may obtain HH preference ratings to assist procurement for the Veterans' Emergency Housing Program, the Civilian Production Administration and the National Housing Agency have announced.

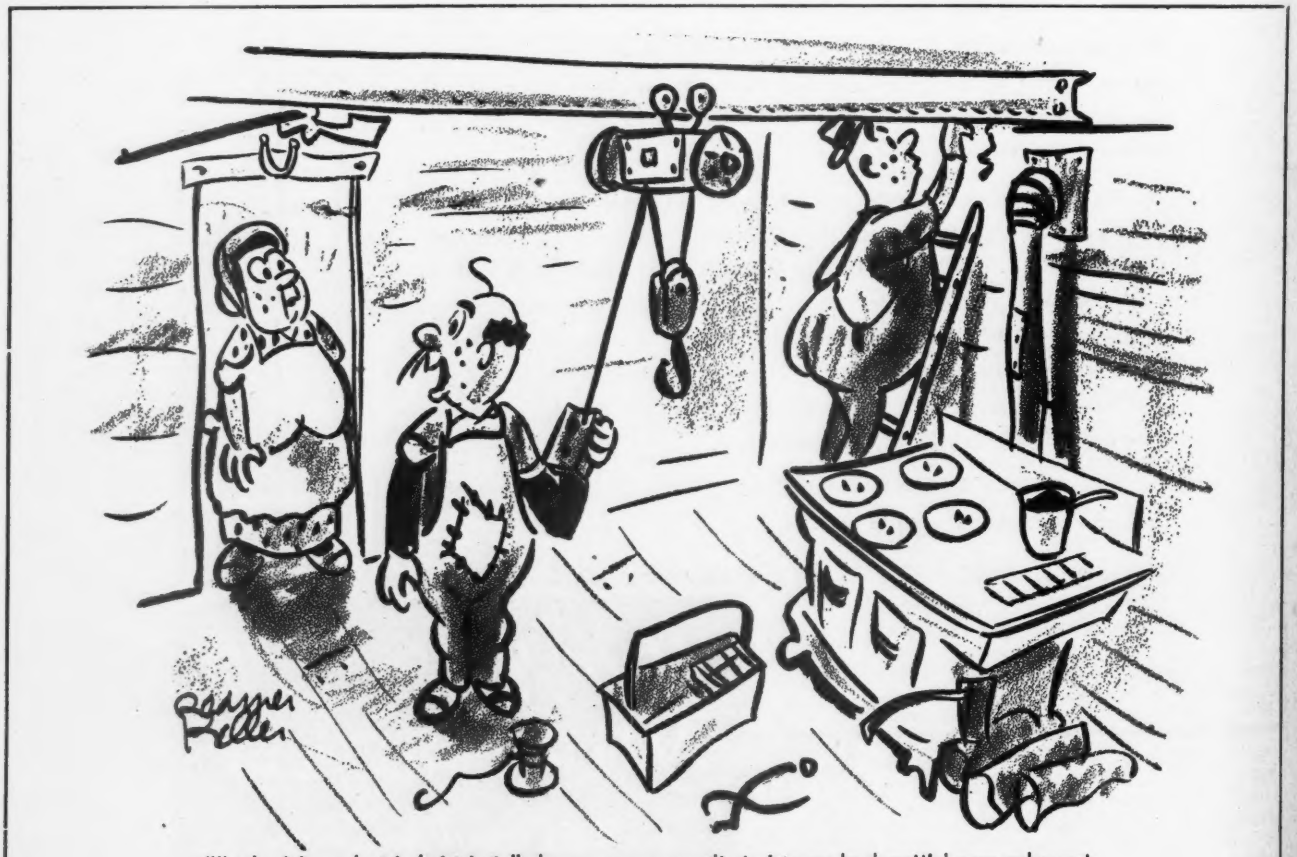
In addition, nails, builders' hardware and electrical wiring devices were added to the list of materials for which HHH ratings may be granted to veterans' temporary re-use housing project contractors.

Electrical wiring devices added to the schedule were the following kinds only: (1) sockets, lampholders, and lamp receptacles—medium screw base types; (2) convenience receptacles (outlets, base plugs): (3) toggle switches; (4) wall and face plates; (5) outlet, switch and receptacle boxes —covers, hangers, supports and clamps included: (6) box connectors for residential-type metallic or non-metallic sheathed cable.

Home Building Declines 16 Percent

The effect of inadequate home building materials and supplies, and in some areas shortages of building craftsmen, was reflected in a 16 percent drop in contracts awarded for residential construction in the 37 states east of the Rocky Mountains in July, it was reported by F. W. Dodge Corporation.

July residential contracts totaled $281,227,000 compared with $332,248,000 in June, and brought the total for the first seven months of this year to $1,914,700,000. During the corresponding seven months of last year



"I'm havin' an electric hoist installed, maw, so you won't strain your back gettin' your cakes out of the oven."

MITCHELL preferred

DISTRIBUTOR

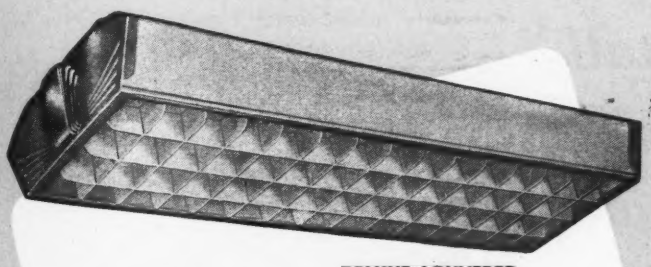
I PREFER MITCHELL Commercial Lighting because it's easier to sell. Both contractors and users recognize and *demand* MITCHELL quality and appearance. Customer satisfaction is assured, and my reputation is protected. That's why *my* Lighting Department concentrates on MITCHELL, the complete line that fills every commercial need.

CONTRACTOR

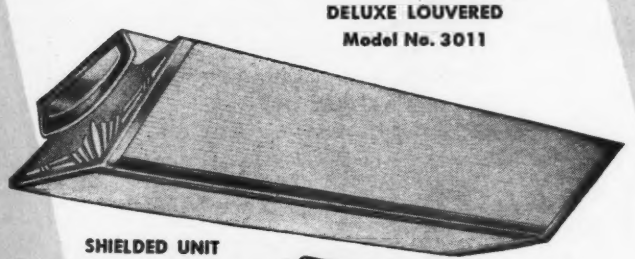
I PREFER MITCHELL Commercial Luminaires because they're easier to install and maintain—accepted absolutely by my customers as top-quality lighting units. I've had plenty of experience with commercial lighting installations, and *I'll* stay with MITCHELL, the line that builds acceptance for my skill and service.

USER

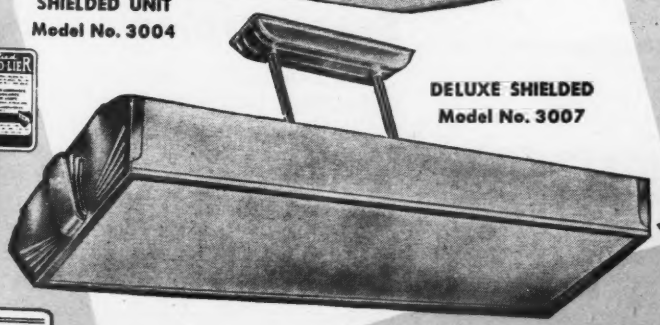
I PREFER MITCHELL Lighting because I know I'm getting carefully planned quality illumination to fit my needs. I like the combination of functional efficiency and modern beauty of design. MITCHELL Commercial Luminaires are a genuine asset to my business. *I play safe —I* buy from the house that sells MITCHELL.



DELUXE LOUVERED
Model No. 3011



SHIELDED UNIT
Model No. 3004



DELUXE SHIELDED
Model No. 3007

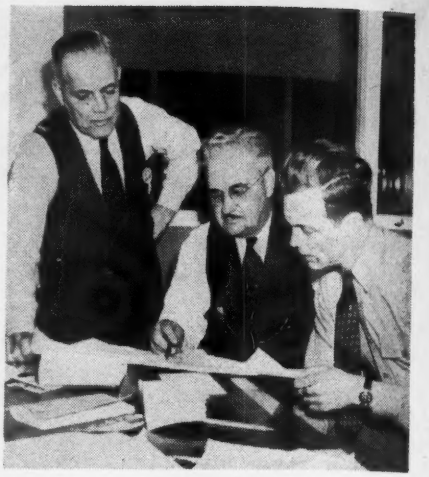
* preferred COMMERCIAL LUMINAIRES

HIGHER LEVELS OF ILLUMINATION
MODERN BEAUTY IN EACH DESIGN
COMPLETE LINE TO FILL EVERY NEED
PREFERRED MITCHELL QUALITY, VALUE

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
1019 NORTH MADISON AVENUE, LOS ANGELES 27, CALIFORNIA

MITCHELL

Makers of Commercial and Industrial Fluorescent Lighting Equipment
Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties . . . Rad-I-Air Germicidal Units (made by Tru-Air Ultraviolet Products Co., Los Angeles.)



Supervising electrical reconversion work at the Kaiser-Frazer Corp. Willow Run plant are: (L to R) W. Gibson, project supt.; Fred C. Snow, manager; and W. R. Turner, vice-president—all of the Turner Engineering Company, Detroit electrical contracting firm doing the work.

residential contracts totaled $243,782,000 in the states east of the Rockies.

Public housing contracts were an important part of the July volume, with $31,917,000 or 11 percent of the total of all residential contracts being listed as publicly owned. Home builders believe that one factor in this sizable volume of publicly owned housing may be attributable to the top priorities given to public housing as compared with priorities issued for privately owned home construction, the Dodge corporation reported.

While home building contract volume was receding, non-residential construction contracts showed a modest gain from $273,207,000 in June to $283,635,000 in July. Commercial, educational, science, hospital and institutional building volume showed gains. Manufacturing building contracts declined but still represented the most active kind of non-residential building investment, with a July total of $129,302,000.

Lighting Institute Reopened at Nela Park

The General Electric Lighting Institute at Nela Park, Cleveland, following completion of an extensive rebuilding program, was reopened September 9. The Institute was closed during the war.

Sweeping changes revealed include not only those of a physical nature but of educational displays and demonstrations as well. The Institute has

been completely rebuilt to serve both present and future needs of G. E. Lamp Department.

The Lighting Institute, which has had nearly one million visitors from all parts of the globe during the 25 years between the two world wars, will resume its series of lighting "schools" immediately after the opening week.

Generally hailed as "Lighting Headquarters of the World at the University of Light, Nela Park", the Institute in its new form is designed to serve as a fountain-head of lighting knowledge and information on lamps of all kinds for every purpose. Prominently featured in a variety of ways are circline and slimline fluorescent lamps, as well as newly developed heat, drying and germicidal types.

Newly styled Institute educational programs are designed to speedily relay latest lighting and lamp information on to the consuming public through commercial, industrial and residential channels.

In his journey through the new Institute, the visitor will be put on intimate terms with virtually all forms of latest lighting applications, mainly by means of a series of "seeing is believing" displays and model installations.

New institute displays include a luminous "diorama" exhibit depicting the history and progress of lighting and lamp development, a glass-enclosed observation promenade commanding a clear view of Lake Erie, in one direction, and the "Fountain of Light" with underwater rainbow lighting by night, in the other direction.

The pomenade's huge windows are made of Thermopane. They play an important role in providing proper air conditioning which prevails throughout the entire Institute. Also freely used throughout the structure are adroitly positioned germicidal lamps.

Among other displays, demonstrations, and facilities built into the revamped Institute are the following:

A color quality room to show the effects of light on merchandise; up-to-minute lighting in the Institute offices; a patio "Sun Deck" capable of furnishing from three thousand to five thousand footcandles with infra-red and ultra-violet radiation equivalent to that of midsummer sunshine; an office lighting room featuring fluorescent principles, accessories and equipments; an ideal school room flooded with synthetic daylight and equipped with automatic electronic controls to compensate for the caprice of natural day light; incandescent lighting for school rooms and a system of brand new low brightness 4-foot 40-watt fluorescent lamps; school wall slates of glass in various colors and chalks of contrasting hues.

J. D. O'Conner, of Lupen & Hawley, Sacramento, who finished up his term as president of the Northern California Chapter, NECA, and its governor, to help in the formation of a new Sacramento Valley chapter. He here discusses the matter with T. L. Rosenberg, Oakland contractor, vice president of Division 6, while William Welch, manager of the Sacramento association listens in.

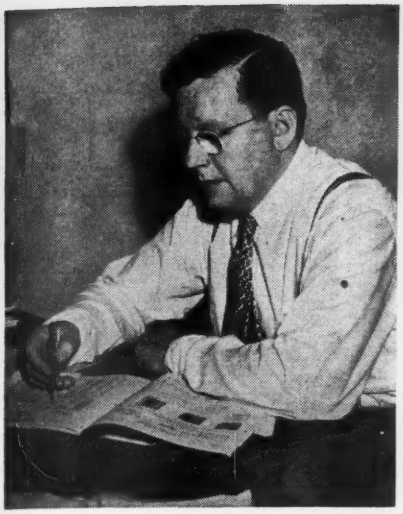
Apprentice-Training Program In Chicago

The Chicago electrical industry has established an all-time record for the number of apprentices in a building trade included in a single registration with the Federal Committee on Apprenticeship. This registration includes 414 electrician apprentices, of whom 378, or more than 91 percent, are veterans.

Under the Chicago Joint Electrical Apprenticeship Program, set up by representatives of employers and labor, liberal credit toward completion of the term of training is given for previous experience in the trade. The training standards stress that allowance of such credit is especially important at this time so that the development of electricians can be advanced more rapidly than usual to overcome the shortage of craftsmen in the trade. Apprentices are being trained for three separate branches of the electrical trade: construction electrician, motor repair electrician, and neon tube bender.

Aluminum Conductors For Building Wires

Postwar shortages in the copper supply have resulted in proposals for the use of aluminum wire as conductors for insulated wires and cables employed under the conditions generally covered by the National Electrical Code. Sections 1109 and 3107 of the forthcoming 1946 edition of the Code refer to the lower conductivity of aluminum. However, none of the provisions of the Code as to dimensions



Electrical work in institutional buildings is the specialty of F. J. O'Toole, owner of the F. J. O'Toole Company, Detroit. His organization now occupies spacious new quarters at 850 West Baltimore Avenue.

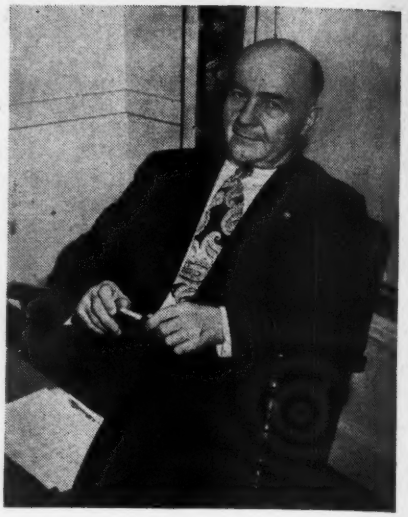
of wires, allowable currents, temperature ratings of insulation, etc. were compiled or were intended to be applied to products with conductors other than of copper. The Underwriters' Laboratories, Inc. standard for rubber-covered wires and cables assumes that conductors will be of copper.

The use of aluminum requires special consideration because of certain differences in properties and performances as compared to copper. Underwriter's Laboratories, Inc. has notified its electrical council and manufacturers of building wires that effective September 1, inspected R-C wire labels may be used on conductors No. 12 and larger.

Fire-Resistant Wood Construction Costs

A detailed study has been made to determine the relative cost of multiple-dwelling, or apartment buildings, using fire-resistive construction as compared to non-fire-resistive construction. This study was based on apartment buildings six stories in height, located in the boroughs of Brooklyn, Queens and Manhattan, New York City. It was made by a special committee organized under the joint sponsorship of the Steel Joist Institute, the American Institute of Steel Construction, and the American Iron and Steel Institute. The committee's findings have been summarized in a 60 page report.

This report explodes the theory that fire-resistive construction in multiple-dwelling housing is considerable more expensive than wood, or non-fire-resistive construction. Some of the facts



Carl J. Schoeninger is the new secretary-manager of the Detroit Electrical Contractors Association. Previous to taking over the managership of this Detroit Chapter, NECA, Mr. Schoeninger was chief electrical inspector of the City of Detroit for three years and design and operating engineer for the Detroit Department of Water Supply for 19 years.

established by the investigation are as follows:

1. The cost per rentable room for a six story multiple dwelling of fire-resistive construction, as compared with a similar building of non-fire-resistive construction is generally lower. In cases studied the amounts varied up to six percent.
2. A gain of 8.6 percent (average) in the number of rentable rooms can be made through planning as allowed for fire-resistive construction under New York laws.
3. The gain in rentable rooms adds an initial total building cost of 5.1 percent (average). Increased rental income permits recovery of this added cost in 2.2 to 7.6 years of operation.
4. An increase in rental income averaging 7.1 percent results from fire-resistive construction (at a cost increase of 5.1 percent average).

Itemized estimates and cost analyses were based on 1939 prices. Electrical work was estimated at $120.00 per apartment for non-fire-resistive construction, and at $142.00 for fire-resistive construction. Lighting fixtures were not included as part of the electrical work, but were included under special allowance.

Total costs of lighting fixtures per multiple dwelling building ranged from $1,500 to $3,600, over the seven case studies involved.

Montana Contractors Form Association

Electrical contractors meeting at Sidney, Mont. recently formed the Eastern Montana Electrical Contractors Association. Louis J. Lee, Sidney, was elected president; Fred Roesner, Fairview, secretary-treasurer.

A committee was appointed to draft by-laws of the new association and make its report September 8 at Miles City.

DATES AHEAD

Illuminating Engineering Society—National Convention—Chateau Frontenac, Quebec, Canada, September 18-21.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., September 24.

International Association of Electrical Inspectors—Northwestern Section, Hotel Boise, Boise City, Idaho, Sept. 23-25; Southwestern Section, Hotel Sacramento, Sacramento, Calif., Sept. 30-Oct. 2; Southern Section, Asheville, N. C., Oct. 14–16; Western Section, Gibson Hotel, Cincinnati, Ohio, Oct. 21–23; Eastern Section, Mark Twain Hotel, Elmira, N. Y., Oct. 28–30.

International Association of Electrical Leagues—Eleventh annual conference, Hotel Astor, New York, N. Y., October 2–4.

National Electronics Conference — Edgewater Beach Hotel, Chicago, Ill., October 3–5.

New Jersey Council of Electrical Leagues—Convention, Berkeley Carteret Hotel, Asbury Park, N. J., October 5–6.

National Safety Congress—Hotels Stevens, Congress & Palmer House, Chicago, Ill. Week of October 7.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., October 8.

George Washington Chapter IAEI—Board Room, District Bldg., Washington, D. C., October 14.

International Municipal Signal Association, Inc.—Annual Meeting—Miami Colonial Hotel, Miami, Fla., October 14 to 17.

National Electrical Contractors Association—Annual Meeting, Ritz Carlton Hotel, Atlantic City, N. J., October 14–18.

Electronics Trade Show—Second annual show, Elks Temple, Los Angeles, Calif., October 18–20.

Ohio Chapter IAEI—Gibson Hotel, Cincinnati, Ohio, October 24.

National Association of Refrigeration Contractors — Annual meeting, Cleveland, Ohio, October 27 and 28.

National Electrical Manufacturers Association—Annual meeting, Hotel Traymore, Atlantic City, N. J., week of October 27.

National Electrical Manufacturers Association — Annual Meeting — Marlboro-Blenheim and Claridge Hotels, Atlantic City, N. J., October 28 to November 2.

All Industry Refrigeration and Air Conditioning Exposition—Public Auditorium, Cleveland, Ohio, Oct. 29–Nov. 1.

National Farm Electrification Conference—Chicago, Ill., November 7–8.

International Municipal Signal Association—51st Annual meeting, McAllister Hotel, Miami, Fla., November 11–14.

George Washington Chapter IAEI—Board Room, District Bldg., Washington, D. C., November 11.

Missouri-Kansas Chapter IAEI — Hotel Leon, Hutchinson, Kansas, November 12.

George Washington Chapter IAEI—Board Room, District Bldg., Washington, D. C., December 9.

American Institute of Electrical Engineers—Winter Convention, New York, N. Y., January 27–31, 1947.

Electrical Engineering Exposition — 71st Regiment Armory, New York, N. Y., January 27–31.

International Heating and Ventilating Exposition—Lakeside Hall, Cleveland, Ohio, January 27–31.

George Seaman, head of field service for NECA, signs up the charter for the newly formed Sacramento Valley Chapter of NECA, with William Welch, manager.

Manufacturers News

G-E APPOINTMENTS

The retirement of W. Stewart Clark as manager of manufacturing for the General Electric Company's nationwide Appliance & Merchandise Department, and the appointment of Carl M. Lynge, general works manager of the G-E Bridgeport plant, to succeed him, have been announced.

R. E. Joines, who was recently named acting manager of construction materials sales for the G-E Company in the Southeastern District, has been appointed district manager. Mr. Joines' headquarters are in Atlanta.

Reorganization and expansion of the G-E Apparatus Department's Special Products Division, calling for establishment of four separate sections and a marketing and promotion group, has been announced. The new section heads are Harrison Johnstown IV, Laboratory Products Section; S. Martin Jr., Power Rectifier Section; C. W. Bowman, Process Instrumentation Section; and D. Lee Chestnut, Educationnal Section. C. W. Merritt was named to take charge of the promotional activities group.

The General Electric Credit Corporation has opened offices in Birmingham, Ala., Memphis, Tenn., and Richmond, Va. O. P. Pearson has been appointed manager of the Birmingham office with offices in the Comer Building; Chester E. Mighell is in charge of the Memphis office in the Sterick Building; and Arthur Parker, Jr. has been named manager of the Richmond office located at 1106 East Main Street.

GRAYBAR APPOINTMENTS

John P. Lawton has been appointed manager of the Northwestern District of the Graybar Electric Company. He will make his office at Northwestern District Headquarters in Seattle, where he has served as district sales manager

since December 1944. Mr. Lawton succeeds J. I. Colwell, who has retired after more than 42 years of service.

Wayne J. Perry has been appointed district Power Apparatus manager and John P. Lenkerd district manager, Radio Broadcast and Sound Equipment Sales of the Mississippi Valley District of the Graybar Electric Company.

SYLVANIA APPOINTMENT

George C. Connor has been appointed general sales manager of the Electronics Division of Sylvania Electric Products Inc.

During the early part of the war, Mr. Connor was liaison agent between

G. C. CONNOR

Sylvania Electric and the government on the engineering development of radio and radar products, and in 1943 he established the company's West Coast Sales office.

WARD LEONARD APPOINTMENTS

Ward Leonard Electric Co., Mount Vernon, New York, has announced the establishment of a new Boston District office at 38 Newbury St. Kasson Howe, formerly with the home office Sales Engineering Department, has been appointed district manager.

Two new sales representatives have been appointed, the L. F. Church Company, 750 Natoma Street, San Francisco, Calif. and Marvin H. Kirkeby, 237 Sheridan Ave. So., Minneapolis, Minn.

VICTOR ELECTRIC ACQUIRED BY MAXSON CORPORATION

Victor Electric Products, Inc., Cincinnati, manufacturers of the Victron line of electric fans, ironers and fractional horsepower motors, has been arquired, through an interchange of stock, by the W. L. Maxson Corporation, New York.

There will be no change in Victor

management, name, or personnel. Charles L. Harrison remains as president of Victor, T. R. Harris as vice president and general manager, and Leslie E. Gaut as vice president and general sales manager. Additions to the Victor Board of Directors include: William L. Maxson, chairman, H. A. Leander, Harold Kondolf, and Thomas Shanahan, all of New York. Mr. Harrison will also become a director of the Maxson Corporation.

ALLIS-CHALMERS APPOINTMENTS

F. A. Fullerton, for 20 years with the Detroit Edison Co., has joined the central station and marine sales and engineering department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

R. W. Gillmore has been named manager of a new Allis-Chalmers branch office in the Claremount Hotel Building, Evansville, Ind. Mr. Gillmore has been associated with the Indianapolis district office as sales engineer.

NOMA ELECTRIC MERGES WITH POLLAK MANUFACTURING

The directors of Noma Electric Corporation and Pollak Manufacturing Company have approved the merger which will be effected through an exchange of stock on the basis of two-thirds of a share of Noma for each share of Pollak common stock.

Leo L. Pollak, Carl Schlesinger and Peter Calabro, vice presidents of the Pollak Company, will become vice presidents of Noma Electric. Mr. Pollak and Mr. Schlesinger will become directors of Noma.

Seymour Mayers has been named sales representative in New Jersey, Maryland, the District of Columbia Virginia and Philadelphia for Noma Electric Corporation.

●

Westinghouse Electric Supply Company has announced the appointment of Jordan K. Silver as manager of the New Haven, Conn. branch. He succeeds Henry E. Mitchell, who will continue as special representative.

●

The Reliance Electric & Engineering Company, 1088 Ivanhoe Road, Cleveland, has established additional sales offices and expanded its present field sales force.

George E. Law, who, since his return from the Armed Services has represented the company in Minneapolis,

will head a new branch office in Appleton, Wis. M. J. Sandling, who has served Reliance in western Michigan for the past several years, will head a new office to be opened in Grand Rapids. He will be assisted by W. F. Cliff, electrical application engineer. William K. Schlotterbeck rejoins the Philadelphia office as sales engineer. E. H. Koontz, sales engineer, who during the war handled subcontracts in a naval ordnance program in Minneapolis, is now with the New York office.

Other sales engineers recently assigned to field sales offices are: R. L. Custis to New York; D. M. Larson to Minneapolis; A. C. Perrin to Chicago; and Albert Mann to Detroit.

•

Formation of the **Stevens Manufacturing Company** to engage in the design, manufacture and sale of electrical appliance and industrial thermostats was announced recently by W. C. Stevens, president. The company's plant is in Mansfield, Ohio and sales offices are in the Richland Trust Building of that city. Mr. Stevens was with the Westinghouse Electric Corporation for 21 years.

•

The Electric Products Company, 1725 Clarkstone Road, Cleveland 12, Ohio, announces the opening of a new district office at 424 Boulevard Building, Detroit 2, Mich. E. G. Schroeder has been named Detroit district manager. Mr. Schroeder was formerly with the New York State Electric and Gas Corporation and the General Electric Company.

•

The McQuay-Norris Manufacturing Company, St. Louis, Mo., announces the appointment of George F. Platts as general manager of operations of the electric products division. L. M. Persons has been named resarch and development director of this division.

•

Roebling's Sons Company, Trenton, N. J. has announced the promotion of Forest S. Burtch to manager of sales, wire rope division, and William Hobbs, Jr., to manager of sales, aircord division. Mr. Burtch succeeds Earl N. Graf, who recently resigned.

•

M. B. Hott has announced that he has acquired all of the common stock of the **Alliance Manufacturing Company** of Alliance, Ohio, and the **Precision Manufacturing Company** of Bergholtz, Ohio. R. G. Doyle, present general manager and treasurer of Alliance Manufacturing Company will be president of the company.

The Simplet Electric Company of Chicago, elected the following officers at their annual meeting: Eugene E. Smith, vice president: Harold W. Kinander, vice president and E. H. Anderson, secretary.

•

St. Clair Electric Products Company, St. Clair, Mich., has announced the establishment of both engineering and manufacturing facilities for the design and production of standard and special "Clairel" industrial heater and resistor units.

•

Charles H. Burch has rejoined **Curtis Lighting, Inc.** and is now sales representative in the Detroit territory. Mr. Burch entered the armed services in 1941 as Lieutenant in the Signal Corps and was recently discharged as a full Colonel.

•

K. P. Swanson, 204 Chapel St., Abington, Mass. has been appointed representative of the **Progessive Welder Company** in Eastern Connecticut, Eastern Massachusetts, Rhode Island, Maine, Vermont and New Hampshire.

•

The Wiremold Company, Hartford, Conn. has announced the retirement of Edward Rigby after 25 years of active service.

•

Sterling Electric Motors, Inc. of Los Angeles, is erecting a 22,000 square foot unit to their present three acre plant.

•

Howard Oxsen has been promoted to manager of the Seattle branch house of **Fairbanks, Morse & Co.** He succeeds John F. Marquitz who will be assigned new duties elsewhere.

•

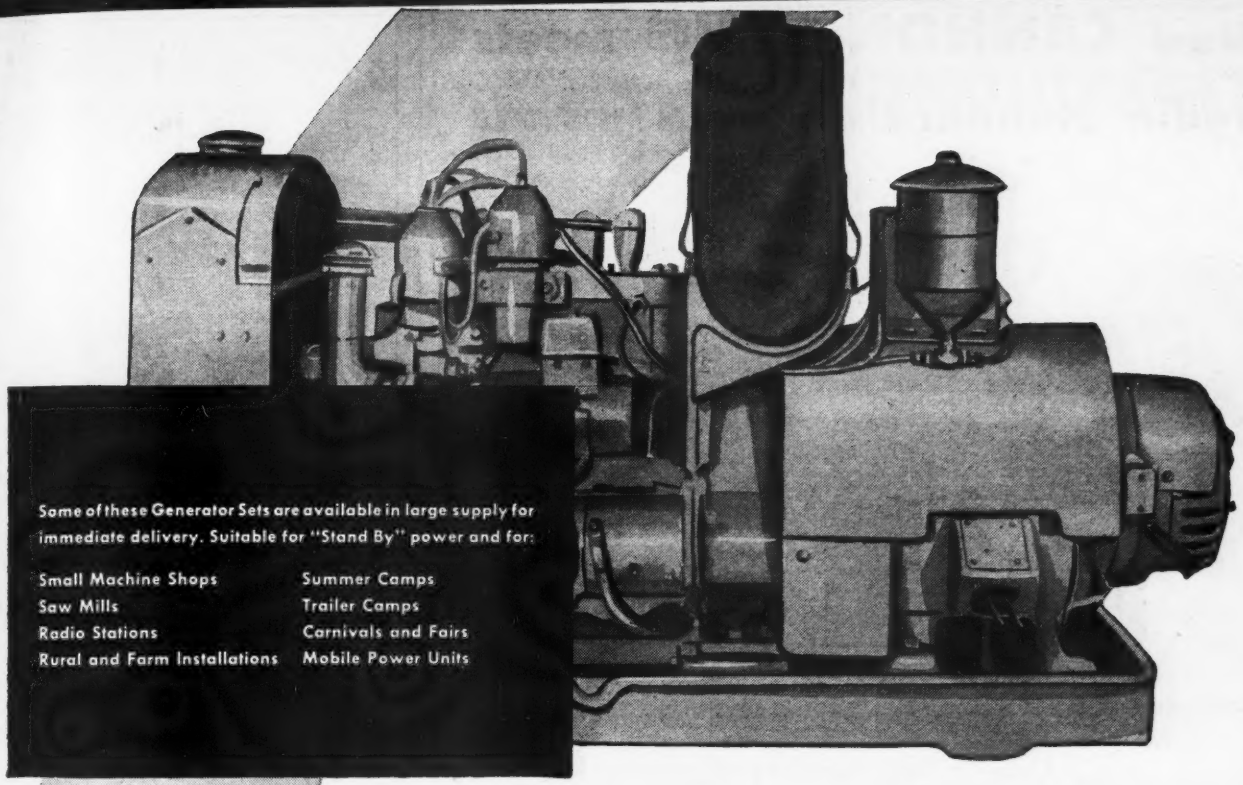
Kellogg Switchboard and Supply Company is erecting a new addition adjacent to present company buildings at 6650 So. Cicero Avenue, Chicago.

•

Cornish Wire Company, New York City announces the appointment of Henry L. Mills as representative in the Los Angeles territory.

•

C. S. Allen, formerly assistant general manager, has been elected vice president and general manager of the **Sawyer Electrical Mfg. Co.** of Los Angeles.



Some of these Generator Sets are available in large supply for immediate delivery. Suitable for "Stand By" power and for:

Small Machine Shops	Summer Camps
Saw Mills	Trailer Camps
Radio Stations	Carnivals and Fairs
Rural and Farm Installations	Mobile Power Units

✓ 120 VOLTS TO 480 VOLTS

✓ 1½ KW TO 30 KW

✓ FROM $250 TO $2500

PORTABLE *Generator* SETS

GOVERNMENT-OWNED SURPLUS

Many Generator Sets, produced by well known manufacturers, are now available from government-owned surplus. The majority of them are new, unused sets, and include the following types:

Gasoline engine driven	Alternating current, 50 and 60 cycle, single and three phase	120 Volts to 480 Volts
Diesel engine driven		1½ KW to 30 KW
Direct current 120-250 Volts		From $250 to $2500

Used sets in good condition at further reduced prices.
All items subject to prior sale.

All Portable Generator Sets are subject to priority regulations. VETERANS OF WORLD WAR II are invited to be certified at the War Assets Administration Certifying Office serving their area, and then to purchase the equipment offered herein.

EXPORTERS:
Most surplus property is available to the export market. Merchandise in short supply is withheld from export and if such items appear in this advertisement they will be so identified by an asterisk.

HOW TO PURCHASE:

1. If you can claim a priority obtain your priority certificates at the nearest W.A.A. Certifying Office, (contact the W.A.A. Office below for Certifying Office address) and make application to purchase.
2. If you do not have priority status simply call any W.A.A. Office below; state the approximate KW rating you desire and the type of machine. You will be told where the machines you wish may be seen and how to complete purchase.
3. If the equipment you wish is not available in your local W.A.A. Regional Office—ask to have national inventories checked by the W.A.A. Inter-Regional Division of your local office and wait for notification of availability.

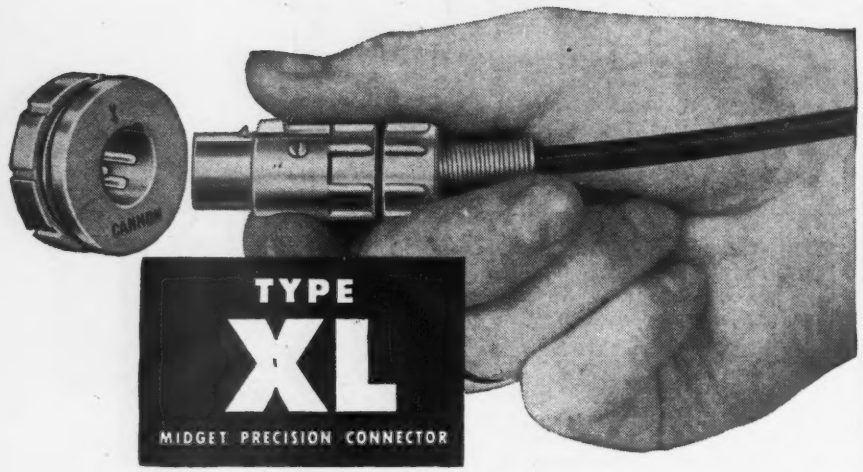
WAR ASSETS ADMINISTRATION

GOVERNMENT OWNED SURPLUS

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Oklahoma City • Omaha • Philadelphia • Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane

655-1

New CANNON PLUG meets radio standardization demands



Designed for all low-level sound transmission circuits

. . . Cannon high quality at a new low price

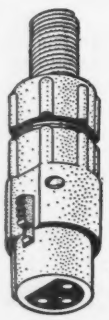
For 15 years Cannon Plugs have been standard equipment on the best microphones, sound systems and other broadcast equipment. Now, with the trend toward parts standardization and the demand for more compact fittings, Cannon Electric introduces the new "radio universal" Type "XL"—manufactured with the well-known Cannon quality, at a new low price.

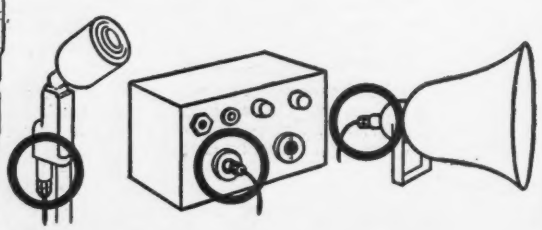
All the quality features you expect in any Cannon Plug are built into the new "XL"—ample voltage and amperage capacities, specially positioned grounding contact, all screw threads tapped in metal, high quality molded insulation.

Ready now are two plug types and four receptacle types with three contacts of 15-amp capacity for No. 14 B&S wire.

Check these **SPECIAL ENGINEERING FEATURES**

1. *Convenient latchlock to hold connection tight.*
2. *Extremely light weight (as low as 1½ ounces).*
3. *Compression gland with cable relief spring.*
4. *Polarized connection.*
5. *Smart, modern design.*





CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, Calif.

Canadian Factory and Engineering Office:
Cannon Electric Co., Ltd., Toronto, Canada

REPRESENTATIVES IN PRINCIPAL CITIES — CONSULT YOUR LOCAL TELEPHONE BOOK

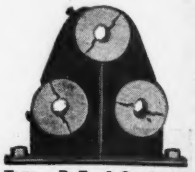
Get this Special "XL" Bulletin. Write Dept. I-231, Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif.

SIMPLICITY PLUS!

New **NON-INDUCTIVE CABLE RACK**

for

INDUSTRIAL PLANT WIRING



Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2⅜".

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushing.

Send today for Bulletin C-S-51 which illustrates the complete line

THE M. & W. ELECTRIC MANUFACTURING CO., INC.

EAST PALESTINE, OHIO

THINK of Revere

For lighting that gives you working footcandles — a great line for SERVICE STATION—SPORTS—AIRPORT — INDUSTRIAL and MARINE SERVICE

QUALITY COUNTS

4200 Series Enclosed Type Floodlight

For sports and other wide area lighting. Rotates in yoke for EASY Safe Maintenance

3800 Series Revere Elliptor

Revere Hinged Pole

Services floodlights from the ground. Clean, working reflectors at all times. 20-24-30 ft. mounting heights. SAFE—no climbing.

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WHERE TO BUY

Equipment, Materials and Supplies for Electrical Construction — Maintenance — Repairs

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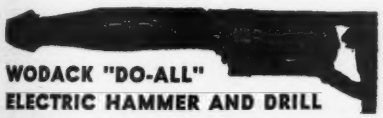
TORK

TURN ANYTHING ELECTRICAL ON & OFF REGULARLY

The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK

DRILL CONCRETE THE EASY WAY



WODACK "DO-ALL"
ELECTRIC HAMMER AND DRILL

Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1⅜" dia., metal ⅜". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, bull points, etc. Ask for Bulletin 442-EC.

Wodack Electric Tool Corporation
4627 W. Huron St. Chicago 44, Ill.
Telephone AUstin 9866

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For
SODERING
Silver Sodering
WELDING

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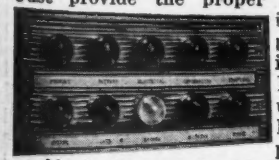
LAMP ANNUNCIATORS

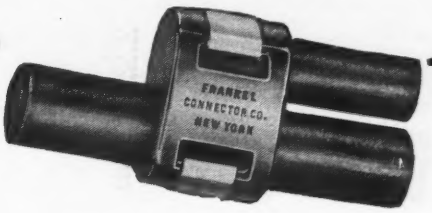
Kirkland Bulls-I-Units are ideal for building lamp annunciators. Just provide the proper size holes in the panel, then insert the Kirkland units and lock into place. Assembly is then ready for installation. Connect incoming wires and place in service. *WRITE FOR CATALOGUE.*



THE H. R. KIRKLAND COMPANY
811 KING STREET MORRISTOWN, N. J.

Frankel

PANEL GUTTERTAP



Designed for use in gutter of panel box

A Connector with Bakelite insulating cover which connects a branch cable to a main cable. Simple, compact construction provides for quick installation within limited space conditions. Its smooth shape makes it easy to tape if used without cover. Ask for catalog No. 4-C.

Frankel Solderless Connectors

FRANKEL CONNECTOR CO.
27 VESTRY STREET · NEW YORK 13, N. Y.

DOUBLE-BRUSH ADVANTAGES

. . . WITH SINGLE-BRUSH HOLDERS

U. S. PAT. 2,181,076

SPEER — Speer Multiflex Brushes give motors and generators the commutating advantages of double brushes with single-brush simplicity . . . and at low cost, too! Their superior performance can be had on practically any type of commutating machine . . . without special adapters or changes in the equipment. Multiflex Brushes slide right into conventional single-brush holders! For the Multiflex design is essentially a single brush split in half. A simple hammer plate attached to one section and overlapping the other, assures equalized spring pressure.

The operating and maintenance advantages of Multiflex Brushes listed at right have been demonstrated over many years wherever commutating equipment is used . . . in power stations, many kinds of industrial plants, and on electric railways.

Let Speer help you match Multiflex Brushes to your machines—write for complete information.

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Get these Commutating advantages with

SPEER MULTIFLEX BRUSHES

• Improved Contact • More Uniform Wear • Longer Brush Life • Less Brush and Commutator Maintenance • Minimum Vibration • Increased Efficiency • Less Sparking and Burning and Similar Difficulties • Better Machine Performance

SPEER
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SEARCHLIGHT SECTION

POSITION VACANT

WANTED: EXECUTIVE thoroughly familiar with electrical appliances and supplies to take full charge of export department. State experience, salary required. P-375, Electrical Contracting, 330 W. 42nd St., New York 18, N. Y.

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SALESMEN WANTED for nationally advertised line. Coverage electrical supply houses, hardware and automotive jobbers. Immediate shipment. High quality men desired for personal coverage on commission basis. State age, experience and references. 430 Board of Trade Building, Boston 9, Massachusetts.

SALES REPRESENTATIVE: Covering Eastern seaboard manufacturers. Complete coverage electrical supply, plumbing and hardware jobbers from Maine to Florida, as far West as Cleveland and Louisiana. Systematic promotional coverage all or part territory. RW-376, Electrical Contracting, 330 W. 42nd St., New York 18, N. Y.

POSITION WANTED

GRADUATE E.E. age 38. Moving to Los Angeles, California, September 1st. Broad experience. Key position Industrial Power and Light design, field Construction—Motors and Controls Sales engineer, technical writer advertising, sales promotion, electrical editor. PW-377, Electrical Contracting, 330 W. 42nd St., New York 18, N. Y.

SELLING OPPORTUNITY WANTED

REGISTERED PROFESSIONAL Engineer well known among contractors and business people wants to represent manufacturers in the Pacific Northwest area. RA-378, Electrical Contracting, 68 Post Street, San Francisco 4, Cal.

FOR SALE

400 CYCLE Dynamotors. 28VDC input 115VAC output 485VA, shaft extension, black crackle $12.50. Generators 30VDC 300 amperes $22.50. Amplidyne Motorgenerators 28VDC 530W $10.50. Free list Aircraft, electrical, radio parts. Ereco 1006 Hewitt, Everett, Wash.

FREE BULLETIN

"SURPLUS PROPERTY"—How-What-Where: A 32 page 5x8 indexed booklet giving complete information on the purchase of government surplus in all available classifications. Write the Office of Information—War Assets Administration, Washington 25, D. C.

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Portable A. C. Ammeter
Surplus New
Weston Model 528

Dual Range 0-3 Amp. and 0-15 Amp. full scale for use on any frequency from 25 to 500 cycles. The ideal instrument for all commercial, industrial, experimental, home, radio, motor and general repair shop testing. Comes complete with a genuine leather, plush-lined carrying case and a pair of test leads. A very convenient pocket sized test meter priced at **less than 50% of manufacturers list. Your cost ONLY.....$12.50**

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WANTED

Electrical Equipment

1—10,000 KVA—Transformer—66/13.8 K.V.
1—400 Amp.—66 KV—3 pole horn gap switch.
3—200 Amp.—66 KV—Fuses and Holders.
400-800 Ft.—250-500 MCM, 3 Cond., 23 KV Cable.
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Contact Purchasing Agent

Pittsburgh Plate Glass Company
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WE NEED MOTORS:
1½ HP—Single Phase
1750 R.P.M.—Ball Bearing
One or more—any quantity—any make! Wire collect, quoting price and quantity.
KENT ENGINEERING COMPANY
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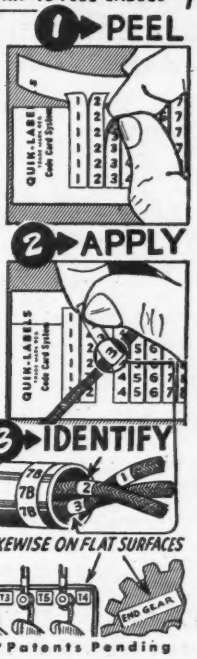
QUIK-LABELS
Mark your wires Faster

QUIK-LABELS code Wires, Leads, Circuits, Relays, Parts, etc. faster and cheaper • *Pre-cut* to exact size, QUIK-LABELS come in rows on handy Cards, stick without moistening. • Replace slow and costly string tags, roll tapes, decals, stencils, metal tabs, etc. • Coated with clear insulating varnish to resist dirt, grease, abrasion. • Removable *Self-Starter Strip automatically exposes ends of Labels for you to grasp instantly—no more finger-picking. • Cost less to buy-and-apply than all other markers. • Maintenance men carry Cards to the job. • QUIK-LABEL Bench Dispenser holds Cards for production operators to code with both hands free. • 275 NEMA Markings and Colors in stock.

Write for Folder and FREE Sample Cards.



W. H. BRADY COMPANY
Manufacturers of Self-Sticking Tape Products
Established 1914
801 N. 3rd St., Milwaukee 3, Wisconsin
Factory: Chippewa Falls, Wisconsin

*Patents Pending

. . . means better lighting at lower cost!

Fluor-O-Shields afford keener visibility — minimize stroboscopic effect, diffuse evenly and soften the light of fluorescent lamps. Fluor-O-Shields fit nearly all open-face fluorescent fixtures — 20W and 40W, single and multiple lamp units. Snap-on clips permit instant mounting. Made of lightweight aluminum, finished in white baked enamel. If your distributor does not stock, ask him to write us.

$1.95 40 watt 46⅞ in. **$1.25** 20 watt 22⅞ in.

SPECIFICATIONS

Cat. No.	Length	Fits Lamp	Units Per Pkg.
27-1-40	46⅞ in.	40 watt	12
27-5-40	22⅞ in.	20 watt	12

**Trade Mark — Patent Pending*

FLUOR-O-SHIELD BY CAMFIELD MFG. COMPANY • GRAND HAVEN, MICH.

Advertising In This Issue

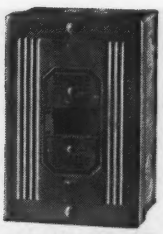
★ These companies have supplied additional buying information on their products in the 1946 edition of the Electrical Buyers' Reference

Wherever you need...

OVERCURRENT PROTECTION

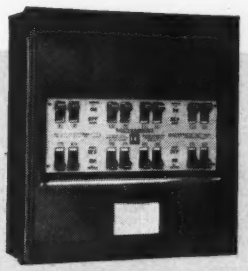
You save time and money with Square D Circuit Breakers

Weatherproof, Dust-Tight and Explosion-Resisting Circuit Breakers.



MO Multi-breaker for use on small machines.

Industrial Circuit Breakers in standard sheet steel enclosures.



Multi-breaker Load Centers for controlling and protecting lighting and small power circuits.

Rain-tight Multi-breakers with a variety of circuit arrangements.

Industrial Multi-breakers in capacities from 15 to 100 amperes, with 2 or 3 poles.

Multi-breaker Load Centers in Cast Iron Enclosures for Class 1, Group D and lower applications.

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HERE'S HOW YOU SAVE TIME...

1 *Harmless momentary overloads pass without breaking the circuit, due to a time-lag feature built into every Square D Circuit Breaker.*

2 *Restoration of service is quick and easy. No replacing of fuses. A simple movement of the operating lever restores current after the cause of the short or overload has been eliminated.*

HERE'S HOW YOU SAVE MONEY...

1 *Fuses are eliminated—no replacement of parts is necessary.*

2 *Electrical equipment has constant proper protection, because every Square D Circuit Breaker unit is factory-sealed and consequently tamper-proof.*

Square D makes exactly the Breaker you need

● Square D's *complete* line enables you to select exactly the right device for any given installation. A wide variety of enclosures, including general-purpose, raintight, dust-resisting, and explosion-resisting. Capacities range from 15 to 600 amperes, up to 600 volts. Send for INDUSTRIAL CIRCUIT BREAKER BULLETIN which illustrates and describes the complete line.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

DON'T PUT UP WITH BLINK FOR A MINUTE!

When a fluorescent lamp that's outlived its normal span starts blinking, the repeated OFF-ON OFF-ON is quick to set nerves on edge.

There's no need to put up with *blink* for a minute, when you use Watch Dog starters. A built-in cutout takes failing lamps off the line *at once*, as soon as their useful life ends. Relamping need not be rushed at an awkard moment that interrupts sales or production. What's more, Watch Dogs protect the ballast and reduce starter replacement cost.

Many fluorescent users are replacing all their starters with Watch Dogs, and are specifying them on all new fixtures. Better tell your customers about this simple way in which fluorescent lighting receives the protection that such high-quality lighting deserves. You'll be a better prospect for more fluorescent lighting installations.

For the full story on these and other accessories which G-E. makes to help you make the most of fluorescent lighting, write Section G16-98, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

Install G-E Watch Dog Starters On All Your Fluorescent Jobs*

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